ARCHIVES OF OTOLARYNGOLOGY

VOLUME 30 OCTOBER 1939 NUMBER 4

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SURGICAL TREATMENT OF DEAFNESS

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During the past three years otologists have been considering their deafened patients from a new and rather startling point of view. Sympathetic acceptance of the disability, followed by the institution of routine forms of treatment, has given way to a spirit of curiosity and an eager hope that something of more substantial benefit may be accomplished. This feeling has developed as a result of the reports of series of cases in which surgical treatment was adopted. After years of effort and persistence in the development of reasonable surgical technics, surmounting almost insuperable anatomic difficulties, the pioneers in this field of surgery have contributed something to knowledge of deafness which promises to revolutionize every previous concept of therapy.

At the moment otologists are almost as eager to grasp at any straw as are the victims of impaired hearing. Which of them has not seen dozens of patients who have "gone the rounds," thinking little of time or cost, in their eager search for relief? It is remarkable that with frequent disappointment these persons can retain hope, and it is in no way strange that many others become disillusioned and depressed at the complete inadequacy of present methods of treatment.

There is one encouraging factor in the otologist's enthusiasm for the new type of therapy—his appreciation of ineffectiveness of present efforts. But of even greater importance is the knowledge that certain persons in this highly specialized field of medicine are devoting their time and energy in an effort to rationalize and perfect the technic of surgical intervention for deafness. Unfortunately this object will never be completely attained in the laboratory, either by the study of pathologic sections or by experimental means. The final proof of any fact, however scientifically evolved by experimentation, will rest on the actual effect of its application on a person with impaired hearing.

Pioneers in the delicate surgery of the ear can protect themselves and their patients only by the thoroughness of their own training and

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Read before the Clinical Society of the New York Polyclinic Medical School and Hospital, New York, March 6, 1939.

their method of selecting appropriate cases. There is no lack of eager candidates for operation; indeed, patients may even demand it, going from one surgeon to another until some operation is finally performed, regardless of whether there is reasonable hope of success. But it must be remembered that a new type of surgical intervention has never evolved without bitter disappointments for both patient and surgeon and infrequently without tragedy. One has only to recall the early days of cranial surgery to be reimpressed with this fact. However, the present status of the surgical treatment of deafness, an outstanding achievement of patience and skill, should hold real hope for those concerned.

A historical review of the attempts to correct defects in hearing by surgical means is hardly necessary at this time. Nor is it necessary to mention the various procedures employed, as the facts have been described in detail by numerous authors in the past few years. From simple myringotomy, first performed for deafness by John Hunter in the eighteenth century, to the surgical procedures of the past and the present century is a far cry indeed and, as Holmgren [1] said, "all such efforts were doomed to failure until asepsis and anesthesia became available." After the appearance of these two revolutionary safeguards to surgery in general, otologists again turned their minds toward the fascinating field under discussion. The pioneers, of necessity, met with discouragement and either abandoned their effort voluntarily or were forced to do so by the adverse criticism of their professional colleagues. At the beginning of the present century active interest was resumed, and it has continued with increasing enthusiasm and with reasonable promise of success up to the present time.

The microscopic pathologic picture of the clinical entity otosclerosis formed the basis of all surgical methods developed during the years from 1917 to 1930. In the past decade revolutionary methods of studying the physiology of the auditory end organ as a whole or of any of its component parts have given a sound basis for concept of function. Again, there is no reason to enumerate these methods of study in detail. Many investigators have devoted their entire time to the newer types of research, using a variety of methods, singly or in combination. Conclusions have not always been in agreement, but the elaborate and complicated technical procedures employed made inevitable such seeming disparities in observed results. There can be little doubt that when the mass of material has finally been completely sifted and analyzed a sound and true foundation will have been laid for the structure on which the physiology of hearing is built. At the present moment it can be

1. Holmgren, G.: Surgical Therapy in Otosclerosis, in Nelson Loose-Leaf Surgery of the Ear, New York, Thomas Nelson & Sons, 1938, chap. 18, pp. 399-430.

said without qualification that the theories already evolved experimentally conform directly to the normal and pathologic functions of the human auditory apparatus.

Interest in the prevention, alleviation and possible cure of deafness can no longer be confined to impairment resulting from otosclerosis. Any departure from normal auditory acuity, whether conductive, neural or combined, must now be scrutinized with an eye toward adopting some type of surgical or radical treatment when all forms of conservative therapy have failed.

STANDARD OF OPERABILITY

To any conscientious otologist the criteria which must be satisfied before the institution of a surgical procedure are self evident. A complete toilet of possible septic foci must be carried out. This is largely a preventive procedure against further progress of the deafness, as an impairment already present is seldom corrected by such general measures. In the past few years many causes of deafness have been newly recognized. These are largely constitutional, general systemic disorders or obscure toxic involvement of the neural mechanism of hearing. Whether direct therapy will be availing or not, the presence of the condition must at least be recognized.

As stated, had direct therapy not proved unavailing after many years of trial, there would not be the present great interest in the newer, surgical, approach. Inflation and bougienage are still more or less universally employed with little regard to the rationale of the procedure. Certainly observation of the patients so treated gives one little reason to feel that the measure is either preventive or curative.

When conservative measures have proved unavailing and the loss of hearing has become a distinct disability, every patient should be prepared to use a hearing aid, whether surgical intervention is contemplated or not. A reasonably long and large experience in prescribing and fitting these instruments indicates that the formerly universal repugnance to their use is on the wane. Patients are now more easily convinced that continued application in their use will bring the desired effect and that the disagreeable qualities of the instruments will become less apparent. Should surgical measures fail, lip reading and a hearing aid may well be the last resort. To become proficient in lip reading after the third decade is a difficult task; a properly prescribed hearing aid is an immediate help to any one with a modicum of residual hearing.

Much is said of the patient's psychologic reaction to an unsuccessful surgical procedure. But what of his psychologic reaction to years of futile treatments? When operation is proposed, the surgeon is a priori faced with a problem in psychiatry, which has been building up for years in many cases. Must all radical treatment be abandoned because

operative failure deepens an already profound depression? Far better for the practicing otolaryngologist to recognize this almost inevitable development at the very onset of the deafness, when conservative measures are instituted, and fortify the patient against impending disappointments and discouragements. Friesner and Druss [2] showed the futility of inflation and bougienage, but, despite their authoritative exposition, the universally futile practice continues. Operation is at the present time the last hope from a therapeutic standpoint, but it is hardly fair that the surgeon should bear the full blame for the unhappy mental state. May not one rehabilitation of a deafened person offset the psychologic effect of several failures? Certainly it is more than any other present type of treatment can accomplish.

SELECTION OF CASES FOR SURGICAL TREATMENT

As mentioned, most surgical efforts designed to correct impaired hearing have been concerned with otosclerosis, and various diagnostic standards have been set up whereby this condition may readily be recognized. In general, such a diagnosis is now made simply on the basis of progressive loss of hearing beginning in the third or fourth decade and associated with tinnitus, lack of marked involvement of the drumhead and relatively normal bone conduction, the last being taken as an indication of a normal neural mechanism. This diagnostic picture is in reality too simple and too easy of fulfilment in any considerable group of deafened persons to be differential. Issue is here being taken only with the diagnosis otosclerosis. It is possible that in many cases of simple conductive deafness, uncomplicated by an acute suppurative episode, all the requirements might be fulfilled. In young persons, particularly, it is unlikely that the neural elements of the ear have been affected. An experimental study of bone conduction reported in 1936 [3] indicated conclusively that bone conduction can be impaired by many conditions other than damage to the neural mechanism of the ear. Crowe and Baylor [4] recently reported cases of chronic otitis media in children in which markedly impaired bone conduction returned to normal when the otitis was successfully treated. His method of estimating bone conduction is not a matter of record. The extraordinary variability of bone conduction in children is not mentioned and cannot, therefore, be

2. Friesner, I., and Druss, J. G.: Critique of the Present Treatment of Deafness Due to Lesions in the Conduction Mechanism, Arch. Otolaryng. **26**:259-267 (Sept.) 1937.

3. Hughson, W.; Thompson, E., and Witting, E. G.: An Experimental Study of Bone Conduction, Ann. Otol., Rhin. & Laryng. **45**:844-858 (Sept.) 1936.

4. Crowe, S. J., and Baylor, J. W.: The Prevention of Deafness, J. A. M. A. **112**:585-590 (Feb. 18) 1939.

accepted as an important diagnostic factor. The observations do not necessarily constitute evidence of neural damage and hence are of small diagnostic importance.

Mobile tympanic membranes and patent tubae auditivae also may be required before operation is undertaken. Inspection of the membrane is usually sufficient to determine its mobility but not that of the ossicular chain or the footplate of the stapes. May not concurrent conditions of all these organs deprive an otosclerotic patient of the possible benefits of operation?

A diagnostic routine is therefore of more importance than the ultimate diagnosis, for by establishing such a routine otologists may make it possible to place many patients in the operable group, and by the same token many will be spared inappropriate and unnecessary operation. Such a diagnostic procedure might be outlined as follows, with the admission that the necessary physical equipment may be available to only a limited number of otologists.

Insistence must be made on repeated preliminary audiograms, certainly no less than three and preferably more. This is not to train the patient in accuracy of response but to establish the expected variation. Recent studies have shown that trained persons with relatively normal hearing may show a variation in response comparable to that of an untrained deafened person. The variation in the specific case must be established for air conduction, and the same attention must be devoted to an accurate analysis of bone conduction. Without entering into a discussion of the relative merits of tuning forks and electric devices for testing bone conduction, it may be said that the latter have been found to demonstrate with great accuracy the status of the patient's hearing by bone conduction. Indeed, within certain limits it is possible to obtain repeated bone conduction audiograms as accurate as those for air conduction. Masking is taken as a matter of course, particularly when there is any wide divergence between the relative acuity of the ears for hearing by air conduction. It is not enough to say, however, that masking has been used. Its type, intensity and method of application must be specified. Reference from the midline can usually be predicted, but, when it is investigated, it should be determined for all frequencies, as transference from one side to the other may develop with a change in the pitch of the stimulating tone. With what degree of impairment can one still hope that some useful hearing may be obtained from a successful operation? In reported series 25 decibels in the critical frequency range seems to be the maximum gain obtained with any degree of consistency. Therefore, a loss of more than 50 decibels in the same frequency range seems to make operation impractical. There may be, however, a legitimate leeway if certain frequencies have been spared in the general downward trend. An operative procedure cannot be

counted on to restore the perception of the two higher frequencies in the audiometric scale to any semblance of a normal level.

Having determined the elementary facts, one should proceed to tests of greater differential significance. Of these, by far the most important is the loudness balance between the two ears, provided the disparity in acuity between the better and the poorer ear is at least 15 decibels. This standard is set because in certain cases the variation in accuracy may be as great as 15 decibels. Regardless of determination of bone conduction, Fowler's [5] constant or variable response conclusively indicates conductive or nerve deafness, respectively. Bone conduction alone can no longer be regarded as a standard means of estimating nerve deafness.

If the footplate is definitely fixed, moderate pressure exerted on the tympanic membrane and thence transferred to the ossicular chain should not reduce the acuity of hearing. Conversely, if such pressure were exerted on a free footplate it would surely affect the response. It has been shown experimentally that changes of less than 5 mm. of mercury in middle ear pressure have no effect on hearing.[6] Such measured pressures may be applied to the external surface of the tympanic membrane and their effect on the acuity of the ear determined by means of a receiver attached to an ear speculum, while the air pressure in the external canal is controlled and measured manometrically.

Fatigue tests have proved of value in differentiating between conductive and nerve deafness. In an ear impaired by a conductive lesion, fatigue will not develop; when the impairment is purely neural, fatigue after stimulation of high intensity is inevitable.[7] The fatiguing tones may be used at an intensity 85 or 90 decibels above threshold without risk of damage to the ear.

Finally, thresholds of intelligibility must be determined in all cases in which it is possible to operate, for they indicate postoperative improvement more clearly than do threshold estimations of individual frequencies. This procedure, it is hoped, will meet one of the severest criticisms of reported operative improvement.

In any discussion of the surgical treatment of deafness it must be understood that consideration is directed solely to those cases in which

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5. Fowler, E. P.: The Use of Threshold and Louder Sounds in Clinical Diagnosis and the Prescribing of Hearing Aids: New Methods for Accurately Determining the Threshold for Bone Conduction and for Measuring Tinnitus and Its Effects on Obstructive and Neural Deafness, Laryngoscope **48**:572-588 (Aug.) 1938.

6. Thompson, E.; Howe, H. A., and Hughson, W.: Middle Ear Pressure and Auditory Acuity, Am. J. Physiol. **110**:312-319 (Dec.) 1934.

7. Hughson, W., and Witting, E. G.: An Objective Study of Auditory Fatigue, Acta oto-laryng. **21**:457-486, 1935.

no suppurative disease is present and in which there is no reasonable possibility of an acute infection developing. Of course, this presupposes an intact tympanic membrane. When a patient is presented for surgical intervention the routine rhinolaryngologic procedures have beeen carried out. Every possible source of infection should, however, be carefully checked. Special examinations and laboratory studies should be made when indicated, and a patient should not be operated on before the Wassermann reaction of the blood has been reported negative.

At this point emphasis must be laid on a thorough search for abnormalities of the blood vessels, such as hypotension, particularly in allergic states, hypertension, whether of old age or not, endocrine disorders and nutritional deficiencies. Although the treatments suggested for these conditions have received but poorly controlled observation, they must be assayed in any adequate diagnostic study. At the moment specific therapy for them has proved of little practical importance. A number of patients, women particularly, present the classic picture of pituitary-adrenothyroid adenopathy. The influence of drugs on hearing is assuming greater importance in every thorough clinical survey.

The actual disability resulting from almost identical losses varies in different persons, perhaps because of occupation, temperament or any of a variety of conditions, and often the advisability of treatment depends more on apparent disability than on the actual audiogram. A direct corollary, the economic importance of the deafness, must be investigated and weighed. If immediate restoration of hearing is essential to maintain a position of economic independence, surgical intervention has no place, and the patient must be persuaded to resort to an appropriate hearing aid. However, if time is not so important a factor, operation may be attempted even though the hearing aid may eventually become necessary.

Emphasis on the influence of heredity seems to be slightly overdrawn. Certainly many patients are seen who have no significant familial background for their deafness, and even when deafness has been present in preceding generations, careful inquiry may demonstrate a tendency toward suppuration rather than any specific disease of the otic capsule. To maintain the incidence of deafness in the general population a few members of almost every family must have some impairment of hearing.

STANDARDS FOR AN OPERATIVE PROCEDURE

The very structure of the human ear, the seclusion of its more vital parts in the temporal bone, precludes the use of the term "simplicity" in connection with any surgical approach for the correction of impaired function. Any operative procedure can be made simple only by the technical proficiency of the operator. There is no need to emphasize

this fact here; yet standards must be set to insure the maximum of simplicity attainable in any proposed procedure. Whether technical proficiency is gained in the laboratory or on the cadaver, the technic must be second nature to the operator before it is applied to the human patient. This is a new type of surgical procedure, dealing with minute but vital structures and conducted in a field in which infection of low grade is probably the rule rather than the exception. No greater tribute can be paid to the pioneers in this branch of otology than to recall the relatively insignificant incidence of infection in the cases reported, which must be attributable not wholly to the aseptic technics employed but more to the meticulous delicacy used in handling tissues and to the observance of strict hemostasis, both cardinal principles of true aseptic surgery.

When he accepts the responsibility of operative treatment the surgeon wishes, of course, to promise some degree of lasting improvement, particularly for young persons. Yet at the present moment it seems hardly likely that any surgeon can make this promise on the basis of any series of cases reported, no matter what procedure has been employed. Although restoration of useful hearing cannot be definitely promised, at least the operation must not involve any possibility of further impairment. Infection cannot always be avoided in any field of surgery, and should it occur in the course of an operation for deafness the result would be disastrous. With full knowledge of this possibility, the patient must be the one to assume the risk. Reasonable assurance that the operation will tend to fix the hearing at its present level in itself justifies operation in cases of moderate impairment of hearing. All deafness is progressive up to a certain point, where it may remain static for years until the factors of age are superimposed on an early acquired impairment. This point cannot be accurately forecast, but in most instances the general loss lies in the rather broad range between 40 and 60 decibels. Unhappily for its success, surgical treatment of deafness is a last resort, seldom sought by the patient or made available by the practicing otolaryngologist, while the loss is between the theoretically most favorable levels, 25 and 40 decibels. Undoubtedly, when the surgical treatment of deafness has become more thoroughly established, operation will be advised when reasonable improvement might mean restoration to a hearing level approximating the normal.

OPERATIONS AVAILABLE AT PRESENT AND THEIR RATIONALE

There is probably no practicing otolaryngologist in the country who is not familiar, in some way, at least, with the procedure of fistulization of the semicircular canals, dramatic alike in the painstaking development of its intricate and skilful technic and in its extraordinary immediate effect on hearing.

Bárány and Jenkins, first, then Holmgren, the real pioneer, followed shortly by Sourdilles and more recently by Lempert, who simplified the procedure and perfected the technic, focused attention on this operation, characterized by implication, if not by title, as a direct treatment of otosclerosis. Insistence on this point may well affect the integrity of the entire procedure. The requirement of normal bone conduction is certainly a safeguard against promiscuous surgical intervention, while observation of the other standards already mentioned cannot help but favor a successful outcome. Holmgren [1] stated that otosclerosis is a progressive disease and hence renders the continued usefulness of a hearing aid unlikely. Would not this same argument hold true of fistulization if it is to be employed only for otosclerosis? It is well known that the disease may involve the walls of the canals or completely obliterate the scalae in cases of extreme involvement. What purpose would a fistula serve under such circumstances? It would seem that the operation must be too important to be restricted in application by a single point of differential diagnosis.

The rationale of the procedure is hardly clear—"decompression of the labyrinthine perilymph," "relief of venous stasis by decompression of the dura of the temporal lobe," "establishment of a new window covered with a thin, flexible membrane facing toward an air-filled cavity" and "a radical operation cavity or a greatly enlarged canal, as in the endaural approach," are all listed as the standards of successful operation. It is difficult to understand why fistulization of the promontory has failed to give results comparable to those of the same procedure carried out on one or more of the canals. Holmgren, though reporting immediate improvement in some cases, abandoned this approach after closure of the fistulas. There is considerable diversity of opinion among the surgeons performing the operation as to the relative importance of the various steps. Certainly the fistula must remain open. Whether Lempert's [8] use of the polishing burr, filling the haversian canals with bone dust, is the answer to the problem remains to be seen. The final results of Holmgren's experiments with radium, mesothorium or platinum wire as a foreign body will be awaited with the greatest possible interest.

The disposition of the ossicular chain or of any individual ossicle is apparently a matter of less complete agreement than any other. If removal of the head of the malleus results in greater freedom of movement of the membrane, why will not complete removal of the incus serve the purpose as well if not better and endanger the intact tympanic membrane less? Is mobilization of the membrane over the fistula

8. Lempert, J.: Improvement of Hearing in Cases of Otosclerosis: A New, One Stage Surgical Technic, Arch. Otolaryng. **28**:42-97 (July) 1938.

an essential feature of the operation? Again, long experience alone will clarify these rather unsettled problems.

If the reported improvement in hearing is found to be maintained over substantial periods, if the preponderant improvement of the thresholds for the lower frequencies gives useful gain in intelligibility and if the patients can be economically rehabilitated, then the future of the deaf is no longer completely dark.

In contrast to this difficult though dramatic operation, the procedure first attempted in 1931, abandoned, and revived in 1937, fixation of the membrane of the round window with a tissue graft, is relatively simple.[9] The operation is technically easy. In the small series, 35 cases to date, there have been no infections, no patient has suffered further impairment, all frequencies have been affected and the maximum useful improvement obtained is as great as that reported for fistulization in any case. The effect is slow in developing, but when once begun it has continued to the limit of time any case has been observed, two years.

In every case observed the drum membrane has healed without significant scarring and with little increase in retraction. In a few cases a small area of atrophy has appeared, after five to eight months, at the site of the incision or at points where small segments of the membrane have actually been resected to facilitate exposure of the niche of the round window. There is no need to elaborate again the technic of this operation except to emphasize that magnification and brilliant illumination of the field are essential to its proper performance. The patients are hospitalized three days and can return to work on the fourth day.

Normal bone conduction is not a prerequisite of operability, for if the often repeated rationale of the procedure holds—and there is no reason to think it unsound—any intact neural elements will receive a more intense stimulation following contraction of the graft in the niche, and the total hearing should consequently be increased. Both ears have been operated on in 3 patients, this being done when the original or poorer ear had attained a lower threshold than the better ear. The second operation is not done until a year has elapsed.

The effect of the operation is not that of simple myringotomy, as has been suggested. During the so-called operative period—while the tympanic membrane remains open—either immediate improvement or impairment may result; in this series 80 per cent of the patients showed impairment while 20 per cent showed definite improvement. When impairment results, return to the preoperative level occurs shortly after the closure of the drum membrane. Audiograms are made every other day during the operative period.

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9. Hughson, W.: Rationale, Technique, Case Reports and Observations with Grafts in the Round Window, Laryngoscope **48**:533-545 (Aug.) 1938.

Another phenomenon of interest noted during the operative period, provided it lasts for two weeks or more, is the vascularization of the graft. By the end of the first week it becomes strikingly pale, while by the end of the second week color is restored and if it is touched with a probe there will be slight though definite bleeding.

In relation to this procedure one point of importance must be emphasized. Whether improvement results or not, the anatomic relations of the middle and inner ear have not been disturbed in any way. If necessity arose, a second operation of any sort could be carried out as easily as on an intact ear. In no published report of fistulization has it been mentioned that patency of the foramen rotundum is necessary. This fact seems to be of considerable importance.

At this point a suggestion will be made which is doubtless open to considerable criticism. When an unusual audiogram is presented, unexplained by otoscopic examination, it seems entirely proper to perform an exploratory myringotomy for diagnostic purposes alone. The risk is insignificant, no greater than that of a routine bougienage, and the information gained may well be the means of devising some useful procedure for a second operation.

Inspection of the middle ear through a wide posterior incision often reveals conditions which were totally unexpected before operation, such as peculiar excrescences on the surface of the promontory or abnormalities in its shape and size. No two round window niches are the same in angle of presentation, contour or diameter. Unexpected filmy adhesions may be present, division of which is probably of slight avail although, as in the abdominal cavity, newly formed adhesions may not exert quite so harmful an effect as those just sectioned. Adhesion of the tympanic membrane to the promontory can readily be corrected, but reattachment promptly occurs, usually with firmer and broader involvement.

Experience with sectioning of the tensor tympani tendon has been entirely disappointing. This is particularly true after observation of the marked effect tension of this muscle has on acuity of hearing in the experimental animal and how readily the impairment may be corrected by relief of the tension.

A discussion of the surgical treatment of deafness would not be complete without mention of section of the vestibular division of the eighth nerve in Ménière's disease and the subsequent improvement in hearing. In the light of Hallpike's microscopic observations on two of Cairn's patients,[10] there seems to be no causative connection between operation and improvement in hearing. These pathologic observations

10. Hallpike, C. S., and Cairns, H.: Observations on the Pathology of Ménière's Syndrome, J. Laryng. & Otol. **53**:625-654 (Oct.) 1938.

require confirmation, however, as experimental data indicate an absence of untoward effect in the presence of increased intralabyrinthine pressures. Dohlman's suggestion that collapse of the wall of the vestibule on the cupola may be responsible for the attacks of vertigo in Ménière's disease falls more in line with the experimental observation that marked decrease in intralabyrinthine pressure causes impairment in acuity of hearing.

This discussion has had a twofold purpose: first, to sponsor with enthusiasm the general principle that in the surgical treatment of deafness lies the future of this part of the otolaryngologist's endeavor; second, by pointing out the burdensome problems of selection and the difficulty of attaining technical proficiency, to keep enthusiasm within bounds and avoid the unhappy result of too ready a resort to surgical intervention. If air conduction is not further impaired and bone conduction is unaffected, as seems to be the case with fistulization, resort can always be made to one of the many electrical hearing aids now available. In the case of the graft in the round window, which does not require normal bone conduction and following which there has never been further loss of hearing by air, the ultimate usefulness of an air conduction aid is in no way impaired. The patient whose condition is appropriate is entitled to the possible improvement which these procedures offer. However much experimental investigation may eliminate the partial darkness in which the rationale of either operation lies, the ultimate elucidation of the problem now rests on clinical observation. The hazards of the methods so far do not seem to be great. Duration of improvement can be determined only by further time. But the entire structure will collapse unless supported by consistent and painstaking follow-up examinations, in which the otologist should use every means available to arrive at an objective measure of the restoration of hearing obtained rather than depend on subjective reactions, tempered as they so often are by a state of elation almost psychopathic.

FURTHER EXPERIMENTS IN THE ACTION OF DRUGS ON THE NASAL MUCOSA

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The following report is supplementary to one of a similar nature made a few years ago.[1] The original communication dealt with the effects of several of the more commonly used drugs on the ciliary activity of the nasal epithelium. Four of the drugs the effects of which are described at this time are in general use; four others are not now part of the rhinologist's pharmacopeia but are included here for other reasons, which will be explained.

The methods employed in these investigations are practically identical with those which are described in detail in the first paper. As in the first instance, three parallel series of experiments were done, the first on the living animal membrane undisturbed in the sinus, the second on material extirpated from animals and the third on material extirpated from the human nose. When the results of these three are identical, it is felt that they may reasonably be applied to the living human membrane.

I. AMPHETAMINE (BENZEDRINE SULFATE, ALPHAMETHYL-PHENETHYLAMINE SULFATE)

Observations were made on the nasal ciliated epithelium (1) of the living rabbit, (2) of extirpated rabbit mucosa and (3) of extirpated human mucosa, with the use of (1) benzedrine inhalers without oil of lavender and with oil of lavender and (2) 1, 2 and 3 per cent solutions of amphetamine in liquid petrolatum.

The effectiveness of the ciliary apparatus depends on the rapidity and amplitude of the ciliary beat, provided that the mucous coating is normal in viscosity. Application of granular material is not necessarily a reliable indicator of ciliary activity, as variations in adsorption and specific gravity may effect the result.

In all cases the active epithelium was observed under the microscope by reflected illumination, and the test substances were introduced

Read at the meeting of the American Laryngological Association, Rye, N. Y., May 26, 1939.

1. Proetz, A. W.: The Effects of Certain Drugs upon Living Nasal Ciliated Epithelium, Ann. Otol., Rhin. & Laryng. **43**:450-463 (June) 134.

through a specially constructed double capillary tube, which keeps the cilia in view at all times during the application. This device consists of two glass tubes welded together and drawn to a double capillary point. One tube is connected to a constant vacuum line. The test substance is introduced into the other tube and allowed to flow by gravity onto the membrane. The vacuum tube picks up the droplets as they strike the membrane and restricts the substance to a small area. This restricted application has a twofold advantage: First, it prevents overflow into the nose and choking and guards against poisoning the animal by flooding the trachea or the digestive tract with the test solution; second, by keeping the surrounding areas intact it provides controls adjacent to the areas under scrutiny.

A. *Inhaler.*—The inhaler was attached through adaptors and rubber tubing to one arm of the capillary tube. The control current of air was first passed through the adjacent tube for two minutes to make sure that the drying effect was not sufficient to stop the cilia. At the end of this time the air was allowed to flow through the inhaler, projecting its fumes against the membrane. This stream of vapor was interrupted only occasionally for the purpose of moistening with Locke's solution as required by the drying of the surface of the control area.

1. Plain Amphetamine (Without Oil of Lavender): (*a*) Living rabbits. Rabbits were anesthetized by intravenous injections of sodium amytal, which instillation had been shown in previous experiments not to affect the ciliary beat, at least for the duration of the present experiments. The frontal sinuses were opened, and the cilia of the undisturbed epithelium were observed under the reflecting microscope. The capillary tubes were introduced into the field and a current of amphetamine fumes allowed to flow on the membrane. There was no appreciable change in the amplitude or rapidity of the ciliary beat at the end of twenty minutes, when the experiments were terminated. This was true in every case. Six observations were made.

(*b*) Extirpated membranes from the nose of the rabbit. Strips of nasal membrane from the septum, turbinates and lining of the sinuses of the rabbit were examined in a manner similar to that described except that the membranes were examined in small, flat glass dishes, the Locke solution in which they had been immersed having been withdrawn just previous to the experiment. Here again there was no demonstrable effect after twenty minutes. Six observations were made.

(*c*) Extirpated human tissue. Epithelium from the pharyngeal tonsil removed from children at operation for adenoids was examined similarly. In no case was there any appreciable change after twenty minutes. Six observations were made.

2. Amphetamine with Oil of Lavender (Benzedrine Inhaler): The experiments described in section "1" were repeated, the benzedrine inhaler with oil of lavender being used. The results were identical with those of the foregoing experiment. The number of observations was as follows: (*a*) on living rabbits, 2; (*b*) on extirpated rabbit mucosa, 2, and (*c*) on extirpated human mucosa, 2.

B. *Amphetamine (Direct Application).*—The following results were observed:

1. The pure drug applied to the mucosal surface stopped all ciliary motion instantly.

2. A 1 per cent solution in liquid petrolatum caused slowing in a variable number of minutes, beginning in from three to seven minutes and persisting over the period of the experiment.

3. A 2 per cent solution in liquid petrolatum caused appreciable slowing within a few minutes after application, which occurred in varying degrees over the field, some areas being less affected than others but motion in all areas slowing to 3 to 6 beats per second.

4. A 3 per cent solution in liquid petrolatum caused general slowing and cessation in from three to six minutes, few areas being active at the end of that time.

The number of observations was as follows: (*a*) on living rabbits, 9; (*b*) on extirpated rabbit mucosa, 12, and (*c*) on extirpated human mucosa, 8.

Comment on the Observation of Oily Solutions: There are several factors which render it impossible to make accurate observations of time in studying the effects of oily solutions on the mucus-covered membrane.

First, when oil is applied to the wet mucosa it flows over the entire surface and later breaks into globules of various sizes, which distribute themselves on the face of the specimen. The distribution of the oily solution is therefore unequal, and various fields are affected in different degrees.

Second, if the entire specimen is immersed in the oil, there remains an envelop of watery solution about it for a variable time. In other words, the oil does not "wet" the membrane.

Third, the optical system has been adjusted for observing the cilia in a watery medium. In order to do this, the angle of incidence of the illumination is adjusted so that the light is reflected back into the objective. When now the oily solution is introduced between the object and the objective, light is reflected not only from the oil surface, which can be avoided by the use of an immersion cone, but from the interface between the oil and the mucoid coat, which cannot. Under these con-

ditions, the cilia cannot be seen, and the observation must be interrupted until the oil has flowed away sufficiently to restore the optical system to its previous status. It is at some time during this interval that the effect of the oily solution on the cilia is produced. For this reason, the time of this effect can be recorded in minutes only approximately.

II. ALCOHOL

A word of explanation should precede this report. Although alcohol is not commonly applied directly to the nose or used to an appreciable extent in any nasal medicament, it was studied for the following reason: It is not an infrequent observation that persons imbibing alcoholic drinks—not necessarily in excess—experience an excessively copious and sometimes viscous secretion of mucus from the nose and the sinuses. These phenomena may occur a few minutes to a few hours after the imbibition of the alcohol.

With the thought that this excessive secretion may serve a useful purpose in the eradication of deep-seated infections and that it may be advantageous to apply alcohol locally in weak solutions either by itself or as a vehicle for other drugs, it was included in this investigation.

The same methods being employed, it was observed that alcohol in any concentration in distilled water stops the ciliary beat in a few seconds, the rapidity depending only on the strength of the solution.

When the alcohol was diluted with Locke's solution, however, it was fairly well tolerated, for example:

A 15 per cent solution on extirpated rabbit and guinea pig mucosa caused a slight slowing after five minutes. This was not progressive, however, and the cells were still in good condition and moving actively after one hour.

An 18 per cent solution slowed the cilia at once, and after fifteen minutes practically all motility had ceased. Washing with Locke's solution, however, restored the motility, which continued for several hours, after which the experiment was stopped.

A 20 per cent solution stopped motility at once. If the mucosa is left in this solution for two or three minutes, some motility can still be restored by immersion in Locke's solution, but some areas show destruction of the surface.

A 5 per cent solution of alcohol in Locke's solution was applied in the living rabbit for over two hours without any appreciable effect.

A 10 per cent solution of alcohol in Locke's solution showed no appreciable effect when the experiments were stopped at varying intervals of over one hour.

A 20 per cent solution of alcohol in Locke's solution caused cessation of motility in twenty to thirty minutes, and the cilia could not be resuscitated by Locke's solution.

It is noteworthy that when the membranes have been bathed over short periods in the stronger solutions or for longer periods in slightly weaker ones, the interference with ciliary activity seemed to be due less to any paralyzing action on the cilia than to a disruption of the epithelium itself. There appeared numerous small, fairly parallel crevices or cracks, apparently due to coagulation and shrinkage of the surface. Between these cracks motility often continued for many minutes. The same effect was noted with ether. From this it appears that, should they prove useful, the watery solutions would be harmless in the nose, so far, at least, as ciliary action is concerned.

III. WETTING AGENTS

Agents capable of reducing surface tension have recently found a multiplicity of uses in industry, particularly in augmenting and maintaining wetting, penetration and emulsification. Already they have appeared in soaps, tooth pastes and other products applicable to the human tissues. Numerous chemical agents have this characteristic in greater or less degree. Three of them were chosen for experimentation because they could be obtained in pure form and because one (the first) had already been shown to be nontoxic to rabbits in relatively large doses.

A. *Decylbenzene Sodium Sulfonate.*—In solutions down to 0.1 per cent this substance caused disintegration of the epithelial surface practically at once. The field became filled with cells which had become detached from the surface and swam in the surrounding medium. No ciliary motility was noted on any of these cells. Locke's solution was substituted for the distilled water with the same result. In the living rabbit, motility ceased in three minutes.

A 0.01 per cent solution of the substance in Locke's solution produced slowing of the beat in thirty minutes and entire cessation in forty-five. With the loss of motility there was also some disintegration of the membrane. In the living rabbit no change was noted after one hour.

A 0.005 per cent solution in the living animal had no demonstrable effect after indefinite periods.

B. *Monobutyl Diphenyl Sodium Monosulfonate.*—A 0.1 per cent solution of this substance in Locke's solution caused immediate disintegration of the tissues. A 0.01 per cent solution stopped motility in thirty-five to forty minutes. Disintegration was noted in one hour. The effects of these solutions on the living animal were as described in section A.

C. *Monobutyl Phenyl Phenol Sodium Monosulfonate.*—A 0.1 per cent solution of this substance in Locke's solution caused immediate dis-

integration after twenty-five minutes, which was complete in one hour. The effects of these solutions on the living animal were as described in section A.

Comment.—There are numerous types of wetting agents, and it cannot be predicted from these observations what their effects will be. Experiments are now in progress to determine whether they will be available in the elimination of pathologic secretions.

IV. ETHER, CHLOROFORM AND NITROGEN MONOXIDE

In the following experiments, because of clinical applicability, observations were made on the cilia of the trachea as well as the sinuses of rabbits. The method used for the second group of observations was as follows:

The animal was anesthetized with ethyl carbamate (urethane) injected intraperitoneally. This produced profound anesthesia but had no visible effect on either the vigor or the speed of the ciliary beat. The trachea was exposed through a long median incision in the neck and was freed from surrounding structures for about 2 cm. With the animal on its back, the trachea was slipped over a narrow strip of metal fastened beneath the microscope objective in place of the stage. When a small piece was removed from the front of the trachea, the interior could be readily observed through the microscope with the ultropak attachment used for sinuses. The effects of the ether and chloroform vapor and the nitrogen monoxide gas could be watched.

A. *Ether.*—In a concentrated atmosphere of ether vapor, produced by wetting a ring of cotton placed around the open trachea, the cilia performed in a normal manner over any period of time.

If a current of ether vapor was blown against the epithelium through a small tube, the beat slowed rapidly and stopped while the blast continued. Motion could be suspended for several minutes in this manner, but as soon as the vapor current no longer impinged directly on the area resuscitation occurred within a few seconds, followed by a short interval of highly exaggerated activity. This closely resembles the results of cooling the membrane and is attributed to the cooling effect of the ether vapor and not to any specific effect on the cilia.

Warming the ether apparatus did not alter the phenomenon, but it also did not greatly increase the temperature at the point of impact, where evaporation still maintained enough cold to interfere with motility. In no experiment was there any indication that ether vapor alone caused any damage to the cilia.

In sharp contrast to this, however, was the effect produced by applying a small drop of ether directly to the membrane. In this case

activity stopped promptly and permanently, because of actual injury to the surface cells. A cracking of the surface, similar to that noted under alcohol, occurred.

B. *Chloroform.*—The fumes of this drug also were not found to have any demonstrable effect on the cilia in the living animal. In this case, however, two minutes' exposure of an extirpated strip of membrane to an atmosphere of chloroform vapor stopped all activity, which was only incompletely revived by washing in Locke's solution. Revival did not occur spontaneously without the washing in Locke's solution.

As in the case of ether, the chloroform itself in actual contact paralyzed the cilia at once. In this case they could be partly revived by putting them under Locke's solution within a few seconds. This revival did not persist more than ten minutes, after which there was complete immobility, apparently due to destruction of the cells.

A direct blast of chloroform vapor also stopped motility while the blast was in progress, which was likewise attributed to chilling. Recovery was immediate and motility vigorous.

C. *Nitrogen Monoxide.*—No application that was made in any experiment of nitrogen monoxide to the cilia or to the animal had any demonstrable effect on the ciliary motility, no matter whether the gas was concentrated or mixed with air. Animals kept under nitrogen monoxide anesthesia for twenty minutes and then killed with an overdose of the gas showed normal motility of the cilia, which were examined as quickly as it was possible to reach them after the death of the animal.

Comment.—It would appear from the foregoing observations that the three anesthetics mentioned have no effect per se on ciliary activity when administered in gaseous form.

The cold produced by their evaporation may paralyze the cilia while it continues. This was especially notable with ether and chloroform, although once or twice the cold produced by releasing the gas through the valve of the cylinder had somewhat the same effect.

Actual contact of the fluid, however, is disastrous to the membrane, and it is obviously of the utmost importance to avoid accidental occurrence of such contact in the administration of anesthetics.

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BLOOD CULTURES IN CASES OF OTITIC SEPSIS

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It seems fair to state that of all phlebitic infections, thrombosis of the lateral sinus presents the most constant features. In no other disease is one particular venous channel so regularly and consistently involved. For this reason the bacteremia which is always associated with thrombosis of the lateral sinus becomes the most important clinical finding of the disease. The recognition of the bacteremia is of paramount importance in the diagnosis of the condition and is of value in interpreting especially the course and the prognosis of the illness. In view of this, the significance of interpretation of blood cultures in cases of thrombosis of the lateral sinus deserves special consideration.

Of the great contributions to otology, Libman's [1] original work on thrombosis of the lateral sinus occupies an eminent position. Further investigations on the subject have corroborated his observation that bacteremia can be demonstrated often in this disease and that the invading micro-organism is usually Streptococcus haemolyticus (beta-Brown).

The infected thrombus, which may either be attached to the wall or occlude the lumen, constantly releases thrombotic particles infected with micro-organisms into the blood stream, which is responsible for the characteristic clinical picture of chills and septic fever. Thus it is reasonable to conclude that thrombosis of the lateral sinus is always associated with bacteremia at some time during the course of the disease, especially in the early stages of the formation of the thrombus. As bacteremia is the only uncontradictable direct evidence that the condition offers, the diagnostic importance of blood culture becomes obvious.

From the Departments of Otology and Laryngology and the Laboratories of the Mount Sinai Hospital.

1. Libman, E., in discussion on Gruening, E.: Six Cases of Thrombosis of the Lateral Sinus Operated upon in the Ear Ward of the Mount Sinai Hospital in the Course of the Past Winter, Tr. Am. Otol. Soc. **10**:304, 1906; A Further Communication on the Importance of Blood Cultures in the Study of Infections of Otitic Origin, Transactions of the Ninth International Otological Congress, Boston, 1912, p. 127.

BACTERIOLOGIC PICTURE

The micro-organism isolated from the infected blood stream in cases of thrombosis of the lateral sinus is usually Str. haemolyticus and rarely Pneumococcus type III or some other micro-organism. In twelve years inclusive of 1937, 104 cases of thrombosis of the lateral sinus, including primary thrombosis of the jugular bulb, were observed at the Mount Sinai Hospital.[2] In 2 instances the diagnosis was made at necropsy, and operations were performed in the remaining 102 cases. Of the 104 cases, no preoperative blood culture was taken in 4; the preoperative blood culture was sterile in 8, and a positive preoperative blood culture was obtained in the remaining 92. Thus, the preoperative blood culture was positive in 92 per cent of the cases in which it was taken. The

TABLE 1.—*Bacteriologic Picture of Blood Cultures in Cases of Thrombosis of the Lateral Sinus Observed in Twelve Years*

Total cases	104	
Patients operated on	102	
Diagnosis made post mortem	2	
No cultures taken	4	
Preoperative cultures sterile	8	
Str. haemolyticus	88	92
B. proteus	2	
B. pyocyaneus	1	
Pneumococcus type III	1	
Per cent of preoperative blood cultures positive	92	
Per cent of positive cultures yielding Str. haemolyticus	95.7	

micro-organism isolated in the 92 positive preoperative blood cultures was Str. haemolyticus in 88 cases, Bacillus proteus in 2 cases, Bacillus pyocyaneus in 1 case and Pneumococcus type III in 1 case. Str. haemolyticus, therefore, was obtained in 95.7 per cent of the cases of proved bacteremia (table 1).

Although the hemolytic streptococcus is also the predominant etiologic micro-organism in acute mastoiditis, Streptococcus viridans (alpha-Brown), Streptococcus of the nonhemolytic type (gamma-Brown), Staphylococcus aureus and albus and various types of Pneumococcus have been isolated from infected mastoid bones. Infection of the lateral sinus developed in about 7 to 8 per cent of the cases of mastoiditis due to Str. haemolyticus which were observed at the hospital during the twelve

2. From the service of Dr. I. Friesner.

years under consideration. (In a large number of these cases the patient was admitted to the hospital with the clinical picture of otitic sepsis.) Of 83 cases of mastoiditis due to Pneumococcus type III, thrombosis of the lateral sinus developed in 1. It appears from these considerations that Str. haemolyticus possesses in certain cases of acute mastoiditis a predilection for the lateral sinus.

Rarely such a micro-organism as B. proteus or B. pyocyaneus may become pathogenic and lead to infection of the mastoid bone and also of the lateral sinus. When this occurs, the infection is usually an acute exacerbation of chronic suppuration of the middle ear. Infection with each of these micro-organisms resulted in a fatal issue and happened to occur in children.

The success with which bacteremia is demonstrated is largely dependent on the method of blood culture employed. As the number of micro-organisms which circulate in the blood stream is often scant and as there is a natural mortality among micro-organisms in blood culture mediums, certain principles for the maintenance and enhancement of bacterial growth should be observed to obtain good results. In any technic of blood culture the features necessary to obtain a high percentage of positive cultures are the inoculation of a large quantity of blood, the use of various and rich mediums, daily spreads, subcultures and prolonged observation. The technic of blood culture employed at the Mount Sinai Hospital is described in complete detail elsewhere.[3]

Every once in a while a strictly anaerobic type of Str. haemolyticus is responsible for phlebitis of the lateral sinus. It is necessary, of course, to use suitable anaerobic mediums to recover and grow this micro-organism from drawn blood. At the present time an anaerobic medium is employed routinely in the blood cultures at the Mount Sinai Hospital.

INTERPRETATION OF BLOOD CULTURES

In the interpretation of the blood cultures, much attention should be paid to the fluid mediums. Often the micro-organisms, especially Str. haemolyticus, grow only in fluid mediums and not on solid mediums. To obtain growth in a suitable fluid medium, inoculation with only a small number of micro-organisms is necessary. They will multiply until the maximum concentration of micro-organisms for the medium is reached. On a solid medium, one micro-organism will yield only one colony. When it is realized that the initial mortality of bacteria on solid mediums is considerably greater than in fluid mediums, the value of the fluid medium in culturing micro-organisms can be readily appre-

3. Shwartzman, G., and Goldman, J. L.: Streptococcus Hemolyticus Bacteremia: A Study of One Hundred and Sixty-Eight Cases, Arch. Surg. **34**:82 (Jan.) 1937.

ciated. The analysis of preoperative positive blood cultures in the cases which we have studied shows that growth was obtained in fluid mediums alone in 48.4 per cent of the cultures. Of special importance is the fact that the micro-organism was isolated from only one flask in 22.7 per cent of the preoperative positive blood cultures. When growth is obtained in one fluid medium, it is not infrequently in the most luxuriant medium (table 2).

It is now pertinent to consider the significance of the number of micro-organisms found in blood cultures and accordingly the number present in the blood stream. When the micro-organisms circulating in the blood stream are few, they are more difficult to grow on blood culture. Thus, the growth in fluid mediums alone, especially in one fluid medium, and not on solid mediums indicates a paucity of micro-organisms in the circulation. From a purely diagnostic point of view, however, the number of micro-organisms in the blood stream in thrombosis

TABLE 2.—*Analysis of Mediums of Blood Cultures in Cases of Thrombosis of the Lateral Sinus Observed in Twelve Years*

	One Medium*	Two Mediums†	Three Mediums‡	All Mediums	Mixed Fluid and Solid	Total
Preoperative	23	8	18	49	3	101
Postoperative	3	6	11	29	0	49

* Usually tomato or dextrose broth.
† Usually tomato and dextrose broth.
‡ Tomato, dextrose and plain broth.

of the lateral sinus is of little significance. When one is dealing with Str. haemolyticus, the presence of even a few micro-organisms in the blood stream, or the growth of the micro-organism in only one flask, indicates definitely the existence of infection. The solid mediums are of value largely in the quantitative determination of the concentration of the micro-organisms in the blood stream. Thus, in a case of suspected thrombosis of the lateral sinus, growth of Str. haemolyticus in fluid mediums only, even in a single flask on one occasion, is suggestive of infection of the wall of the sinus, after all other clinical possibilities have been reasonably considered and excluded. The presence of Str. haemolyticus in one flask of fluid medium has the same import in establishment of the diagnosis as discovering growth in all the mediums. Accordingly, under these circumstances, such a finding also is an indication for operative intervention.

CLINICAL VALUE OF BLOOD CULTURES

Since these facts concerning thrombosis of the lateral sinus have been fully appreciated, studies of blood cultures have been especially helpful

in diagnosing septicemia when a vague otitic history is given and the physical findings are inconclusive. The discovery of Str. haemolyticus in such cases has led to the diagnosis of thrombosis of the lateral sinus with consistent accuracy, after all other sources of infection have been logically excluded. Conspicuously illustrative of such instances is the type of sinus thrombosis known as primary thrombosis of the jugular bulb.[4] The patients when examined usually present a healed or healing infection of the middle ear and no evidence of mastoiditis. The history of a recent otitic infection and the presence of septicemia suggest the possibility of a primary thrombosis of the jugular bulb, but the finding of infection of the blood stream with a hemolytic streptococcus establishes the diagnosis when no other focus of infection can be ascertained clinically.

Blood cultures can play an important role in the differential diagnosis of conditions which present the clinical picture of sepsis in association with otitic infections. First of all, in my experience infections of the middle ear and mastoid bone are not associated with bacteremia. An otitic infection with a positive blood culture, especially of Str. haemolyticus, strongly suggests the existence of thrombosis of the lateral sinus or primary thrombosis of the jugular bulb, after all other conditions producing a state of sepsis have been reasonably excluded.

The complication which is likely to confuse the clinical picture of otitic infection is erysipelas. Erysipelas in its earlier stages may produce bacteremia, and the micro-organism always isolated from the blood stream is Str. haemolyticus. The confusing feature of the disease is the fact that the bacteremia may exist during the first day or two of the illness, before the erythematous lesion appears. This has been particularly noted in children. Pharyngeal and nasopharyngeal infections also may cause Str. haemolyticus to appear in the blood stream, but the portal of entry in these instances may be difficult or impossible to discover. When Str. haemolyticus appears in the blood stream because of meningeal or pneumonic infections, the condition as a rule is readily differentiated and diagnosed by evident manifestations and findings relative to the particular organ involved.

A valuable aid in determining the portal of entry of bacteremia when infection from another source is possible in addition to otitic infection is the differential blood culture described by Ottenberg.[5] The number of micro-organisms in the blood drawn from each internal jugular vein and cultured on blood plates is compared with the number in the blood

4. Maybaum, J. L., and Goldman, J. L.: Primary Jugular Bulb Thrombosis, Arch. Otolaryng. **17**:70 (Jan.) 1933.

5. Ottenberg, R.: Differential Blood Cultures, J. A. M. A. **94**:1896 (June 14) 1930.

obtained from a peripheral vein. In cases of thrombosis of the lateral sinus the differential blood culture has shown an appreciably larger number of micro-organisms in the blood drawn from either or both internal jugular veins than in that drawn from the peripheral vein, while in cases of infection not in the head but, for example, in the heart, the kidney or the bone of a limb, the number of micro-organisms was the same in the blood obtained from each jugular vein and from the peripheral vein. Thus, such blood cultures can be helpful in the differential diagnosis of bacteremia resulting from infections of the head and that resulting from infections of the body or limbs.

In cases of bilateral otitic infection associated with bacteremia, the differential blood culture is not a reliable method to determine the side on which the phlebitis exists. Ottenberg showed that in one-half the cases of thrombosis of the lateral sinus with bacteremia the preponderating number of micro-organisms was found, not in the blood from the internal jugular vein on the same side as the thrombosed lateral sinus, but in the blood from the internal jugular vein draining the opposite, or normal, sinus. The most probable explanation for this finding is that in these instances micro-organisms were growing chiefly at the upper end of the thrombus and entered the circulation by way of anastomosis to the opposite, unobstructed, jugular vein. The circulation at the proximal end of the jugular vein and the bulb on the diseased side is far less active than at the end near the torcular Herophili. In every one of the cases in which the preponderating number of micro-organisms was found in the blood obtained from the normal side, an obliterating thrombus was discovered in the diseased sinus at operation. In cases of sinus phlebitis without complete obstruction to the blood current in the sinus, Ottenberg found the larger number of micro-organisms consistently in the blood from the homolateral jugular vein.

It appears after a review of the literature and from my experience that only the type III pneumococcus of all the pneumococci produces phlebitis of the lateral sinus. Even this occurrence is comparatively rare. Thus, blood culture is of inestimable value in the differential diagnosis of pneumonic infections associated with otitic infections. The finding in the blood stream of a pneumococcus other than type III in the presence of a septic picture and otitic infection should make one suspect the existence of pneumonic infection.

On two occasions I have observed infection of the blood stream with Str. haemolyticus complicating mastoiditis due to Pneumococcus type III. The blood cultures were taken because of the development of a septic clinical picture. Both patients had erysipelas. In one instance the erythematous lesion appeared after the blood culture was reported, and in the other there was a suggestive lesion when the blood was drawn for culture.

Repeated sterile cultures represent information which should be seriously considered in the evaluation of conditions under observation.[5a] An otologist who has reliable bacteriologic studies at his disposal should be disinclined to operate for a suspected sinus thrombosis when repeated cultures of the blood are sterile, unless undeniable clinical findings are encountered. This policy has borne satisfactory results, for such conditions after a period of observation have evidenced manifestations which indicated the presence of pneumonia, pharyngeal infection, pyelonephritis, meningitis or some other illness which accounted for the clinical course.

Blood cultures are helpful also in the postoperative management of thrombosis of the lateral sinus. Repeated growth of the micro-organism in cultures after operation suggests that the venous infection has not been entirely obliterated or blocked off and usually indicates that further operative intervention is required. It may be necessary to obliterate more of the end of the lateral sinus near the torcular Herophili or to evacuate an abscess in the jugular bulb. Of course, at times, when the petrosal sinuses and other channels are involved, the phlebitis is beyond surgical approach. In this connection it should be mentioned that a metastatic osteomyelitic focus may also be the source of a persistent bacteremia. Metastases to the various soft parts of the body and articular structures do not seem to give rise to secondary invasion of the blood stream.

It is appropriate at this point to discuss the meanings of descriptive terms usually associated with bacteremia, particularly because of the significance of proper interpretation of Str. haemolyticus in the blood stream. The importance for clarification of such terms has been emphasized by Friesner.[6] Often invasion of the blood stream is described as "transient" bacteremia. This implies that the bacteria, after they gain entry into the blood stream, remain there for a short time only and that the bacterial invasion into the general circulation does not recur. Should, however, the release of bacteria into the blood stream occur repeatedly, the bacteremia is considered persistent.

5a. The significance of sterile blood cultures must be modified in cases in which sulfanilamide has been administered. It has become an accepted observation that sulfanilamide can be responsible for sterile blood cultures in cases of Str. hemolyticus bacteremia. Thus, it is important to emphasize that sulfanilamide may mask the clinical picture so that the diagnosis of thrombosis of the lateral sinus cannot be made. I believe that sulfanilamide should not be administered until after the diagnosis has been definitely established. (Maybaum, J. L.; Snyder, E. R., and Coleman, L. L.: The Value of Sulfanilamide in Otogenous Infections with Special Reference to Its Masking Effect, J. A. M. A. **112**:2589 [June 24] 1939.)

6. Friesner, I.: Infections of the Middle Ear: Acute Systemic Infections from the Ear, Arch. Otolaryng. **14**:257 (Sept.) 1931.

From the diagnostic and the prognostic point of view, it is necessary to establish the clinical importance of bacteremia. For instance, studies on human beings [7] and animals [8] have shown that transient invasion of the blood stream by Str. viridans may occur without any demonstrable suppurative focus and be clinically unimportant so far as any direct relation to the illness or subject is concerned. In human beings this micro-organism has been isolated from the general circulation in the presence of different debilitating conditions and in animals after the ingestion of fatty meals. In a condition such as subacute bacterial endocarditis,[9] Str. viridans is found repeatedly in blood cultures, and accordingly the persistent bacteremia becomes a finding of clinical importance.

Experience has demonstrated also that other micro-organisms, especially Staphylococcus albus, Streptococcus nonhaemolyticus and Bacillus coli, may be discovered in the blood on an occasion without clinical significance. Thus, transient bacteremia from which the micro-organisms mentioned can be obtained may be clinically unimportant and have no diagnostic or prognostic value. It is usually necessary that persistent presence of these micro-organisms in the blood stream be demonstrated before clinical significance can be ascribed to the invasion.

Transient infection of the blood stream with Str. haemolyticus, on the other hand, is always of clinical significance and importance. It indicates the existence of phlebitis secondary to a contiguous inflammatory process or massive invasion of the circulation by the micro-organisms resulting from surgical or traumatic manipulation of an infected area. In a study of 168 cases of Str. haemolyticus in the blood stream, Shwartzman and I [3] were able to find a focus of infection in every instance. In cases of thrombosis of the lateral sinus, nasopharyngeal or pharyngeal infection and erysipelas, it is not uncommon to find Str. haemolyticus in the blood stream on one occasion, but such a discovery should be regarded as information of great import.

Thus, the significance of transient bacteremia is dependent on the micro-organism circulating in the blood on the particular occasion. In some instances the bacteremia must be persistent before it can be considered significant. It seems to me that the term "transient" bacteremia should always be qualified to denote whether the condition is clinically significant or insignificant, and I consider a term such as "frank" bacteremia uninformative.

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7. Lichtman, S. S., and Gross, L.: Streptococci in the Blood in Rheumatic Fever, Rheumatoid Arthritis and Other Diseases, Arch. Int. Med. **49**:1078 (June) 1932.

8. Desoubry, M. G., and Porcher, M. C.: De la presence de microbes dans le chyle normal chez le chien, Compt. rend. Soc. de biol. **47**:101, 1895.

9. Libman, E.: Characterization of Various Forms of Endocarditis, J. A. M. A. **80**:813 (March 24) 1923.

CONCLUSION

The early diagnosis of thrombosis of the lateral sinus or primary thrombosis of the jugular bulb, before the manifest and evident clinical picture has appeared, and the consequent early operation will contribute greatly to diminish the morbidity, the metastases and the mortality from the disease. It is my opinion that adequate and complete studies of the blood culture with their proper interpretation will help to achieve this end to a gratifying degree.

SUMMARY

Bacteremia is the most constant clinical feature in cases of thrombosis of the lateral sinus. Accordingly, recognition of the bacteremia is an important finding for the diagnosis and clinical management of otitic sepsis.

The micro-organism usually isolated from the blood stream in cases of thrombosis of the lateral sinus is Str. haemolyticus. It was recovered from 95.7 per cent of cases of proved bacteremia associated with otitic sepsis. It appears from bacteriologic investigations that thrombosis of the lateral sinus, with rare exceptions, is essentially a disease caused by Str. haemolyticus.

The demonstration of invasion of the blood stream is dependent on the methods used in taking and cultivating the blood. In the interpretation of blood cultures special attention should be directed to the consideration of the number of micro-organisms cultured, and importance should be attached to the growth of micro-organisms in fluid mediums alone. Analysis of the preoperative blood cultures in this series showed that Str. haemolyticus was obtained from the fluid mediums alone in 48.4 per cent of the cultures and from one fluid medium in 22.7 per cent of the cultures. It is my opinion that finding Str. haemolyticus in a case of suspected otitic sepsis, even in small numbers and in fluid mediums alone, establishes the diagnosis of thrombosis of lateral sinus or primary thrombosis of the jugular bulb after all other clinical possibilities have been excluded. With this concept in mind, blood cultures should contribute greatly to the diagnosis of septicemia when there is a vague otitic history with inconclusive physical evidence.

Proper interpretation of blood culture can be helpful also in the management of proved otitic sepsis and in the differential diagnosis of conditions simulating otitic sepsis. In cases of clinical sepsis associated with infections of the middle ear, sterile blood cultures also give information of great value. In this connection it is important to emphasize that in my experience infections confined to the middle ear and mastoid bone have not been associated with bacteremia.

It seems pertinent in the discussion of invasion of the blood stream that clinically significant bacteremia should be differentiated from clinically insignificant bacteremia and described as such.

HAY FEVER AMONG JAPANESE

III. STUDIES OF ATMOSPHERIC POLLEN IN TOKYO AND IN KOBE

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On the eastern coast of Asia is a festoon-like group of islands, extending from the tip of Kamchatka on the north obliquely down toward the equator to almost within reach of the peninsula of Malacca on the south, a distance of nearly 2,500 miles (4,000 kilometers). These islands compose Japan proper. They are between 77 and 200 miles (124 and 322 kilometers) wide, and the census of 1935 gave their population as 74,000,000. The area is not larger than that of the state of California, but so extensive is the archipelago north and south that there are subarctic, temperate, semitropical and tropical temperatures.

It is well known that the people in this area have always been free from hay fever, although other forms of allergic disorder, such as bronchial asthma, migraine, urticaria and atopic dermatoses, are as prevalent as in other parts of the world. Missionaries, business men and tourists from America and Europe enjoy equal immunity from hay fever while there. Hawaiian and Californian Japanese who have been perennial sufferers from allergic rhinitis find complete relief as long as they remain in Japan. On their return to Hawaii or America, they invariably experience a recurrence of hay fever after the lapse of a year or two.

PATHOGENIC FACTORS

There are three factors of prime importance in the development of hay fever. They are (1) allergic constitutional predisposition, (2) potent antigenic pollens and (3) the meteorologic condition of the region.

The fundamental principle is shown in figure 1. The factors are interdependent. Absence of any one of the three results in immunity from hay fever.

There is abundant evidence to show that the Japanese possess no racial immunity to allergic disorders. In a survey [1] previously conducted it was revealed that 3.5 per cent of the Japanese population in Southern California showed clinical signs of hay fever.

It is now indisputably established that pollen is the exciting cause of hay fever. The types and quantity of pollen in the air and the

From the Department of Otolaryngology, College of Medical Evangelists.

1. Hara, H. J.: Hay Fever Among Japanese: I, Arch. Otolaryng. **20**:668-676 (Nov.) 1934.

distribution of the vegetation that produces it are principally governed by the combination of edaphic, climatic and topographic factors. Meteorologic conditions, such as temperature, precipitation, humidity, motion of air, amount of sunshine and proximity to a large body of water, are factors of importance. Besides having a peculiar inherited constitution, called atopy, the allergic person must be exposed to pollen in sufficient quantity and for an adequate time. It is after ten to fifteen years of residence in California that men born in Japan first acquire hay fever. Among women the average duration of exposure before the subjective symptoms appear is five years.

WEATHER

In a later study [2] I dealt at length with the weather in Japan. Briefly, the summer in Tokyo and Kobe, Japan, is short, hot and humid, not unlike that of the midwestern cities of the United States or those on the

Fig. 1.—Factors in the development of hay fever.

Atlantic seaboard, with numerous thunderstorms followed by heavy rains. During July, August and September the daily temperatures of these two cities fluctuate between 70 and 80 F., and this is about 10 degrees higher than the temperature of Los Angeles. The relative humidity of Los Angeles is seldom above 65 per cent. In both Tokyo and Kobe the moisture content of the air gradually rises during the spring, until it reaches its peak in July and August. In September the humidity begins to decrease to the prevernal level. The annual average humidity in Tokyo is 72 per cent, in Kobe 75 per cent, in New York 73 per cent and in Chicago 77 per cent.

Precipitation.—Japan is a wet country. The average annual rainfall is 40 inches (1 meter). In Los Angeles it is 10 inches (25 cm.); in New York, 15 inches (38 cm.); in Chicago, 18 inches (46 cm.).

2. Hara, H. J.: Hay Fever Among Japanese: II, Arch. Otolaryng. **21**:9-26 (Jan.) 1935.

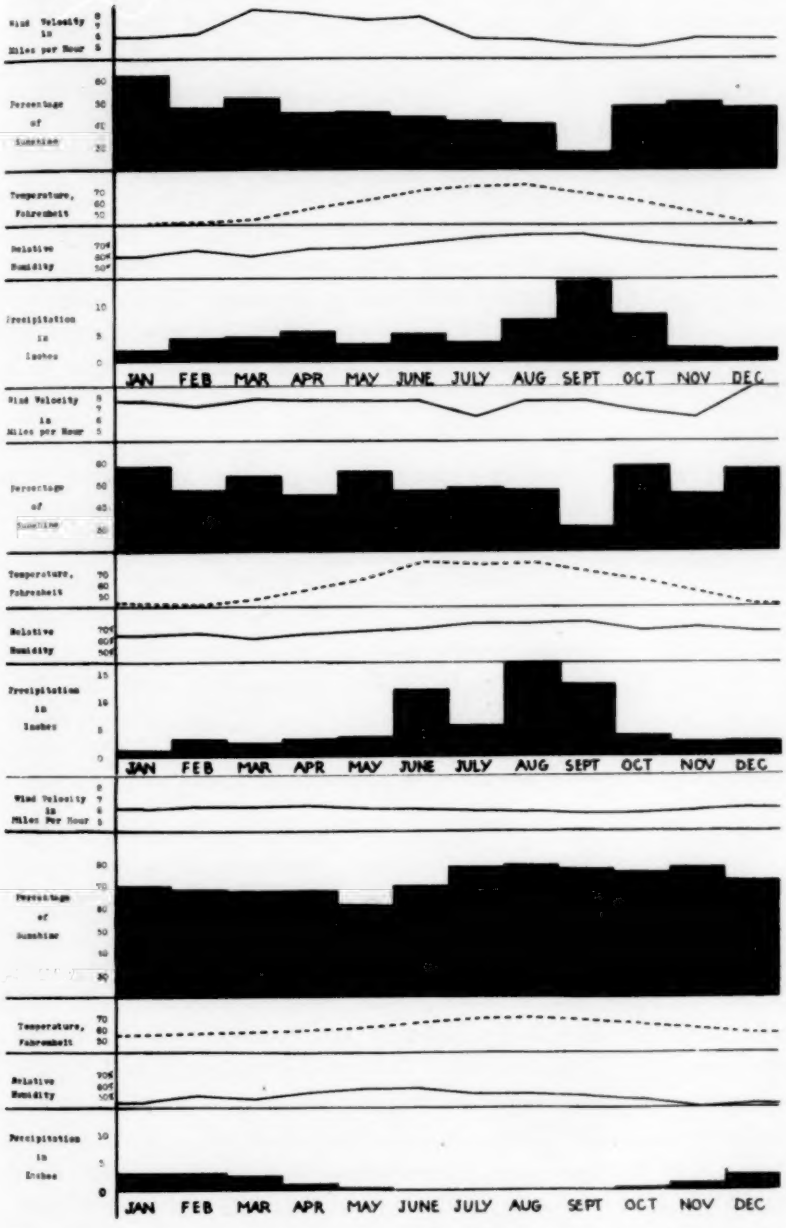
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC
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Fig. 2.—Meteorograms for Tokyo (above), Kobe (middle) and Los Angeles (below).

There are three wet seasons in Tokyo: (1) from the middle of April to the beginning of May; (2) from the middle of June to the beginning of July, and (3) the heaviest, from the latter part of August to the middle of October. January is the driest and September the wettest month in Tokyo. During the four months from November to February only about 18 per cent of the year's total amount of rain falls, and thus the greater portion of the annual precipitation falls in the months when pollination is most active. Kobe has almost the same periods of precipitation. Doubtless this is an important factor in keeping the atmosphere of the island free from dust and pollen. The snowfall is insignificant in the two cities mentioned, seldom attaining a depth of more than 4 or 5 inches (10 or 13 cm.) and melting in a few days. On the average there are about four sunny days for every three days of rain, or a total of two hundred and fifteen days of sunshine and one hundred and fifty days of rain or snow.

Direction and Speed of Wind.—Two opposing ocean currents bathe the shores of the islands. One is known as the Japan current, and the other is the Kurile stream. The first is warm, and the second is cold. During the winter the winds come from Siberia; often they acquire considerable velocity, and it is icy cold. During the spring and summer the winds are reversed. Influenced by the Japan current, the air is balmy, and the breeze is light; during the summer, however, the air is sultry and at times unbearably humid. Figure 2 present meteorograms of Tokyo, Kobe and Los Angeles.

POLLEN ENUMERATION

The absence of hay fever in Japan prompted me to investigate the pollen contents of the air in Sapporo, Japan, in 1934. This is one of the largest cities, located on the island of Hokkaido in the extreme northern part of the empire. Because of its situation, the winter in Sapporo is long and extremely cold, the temperature going as low as 10 degrees (F.) below freezing and remaining there for weeks. The summer is short and mild. Thus the pollinating period in Sapporo is comparatively short.

The present investigation deals with the pollen content of the atmosphere of Tokyo and Kobe. Both these cities are located on the main island, considerably south of Sapporo, and facing the Pacific Ocean. Tokyo has been the capital of Japan for the past seventy years, and its population, according to the census of 1938, is 6,963,900. Kobe has a population of 980,000 and is noted for its industries and foreign trade.

The city is built on the hillside on the shore of the inland sea. These two cities were chosen because their climatic conditions appear to be fairly representative of the island.

During 1936, through the cooperation of my brother, Dr. Sabro Hara, a practicing physician in Kobe, I was able to obtain a series of glass slides which had been exposed to the air of Tokyo and Kobe from March to November. The slides measured 1 by 3 inches (2.5 by 7.6 cm). They were covered with a thin coat of petrolatum and exposed for each twenty-four hours, about 100 feet (30 meters) above sea level, in the corner of a garden. At the end of the twenty-four hours each was collected, dated and packed in a dust-proof box; later the slides were shipped to me for study of the pollen. On reaching America they were thoroughly examined by assistants in my office to determine the

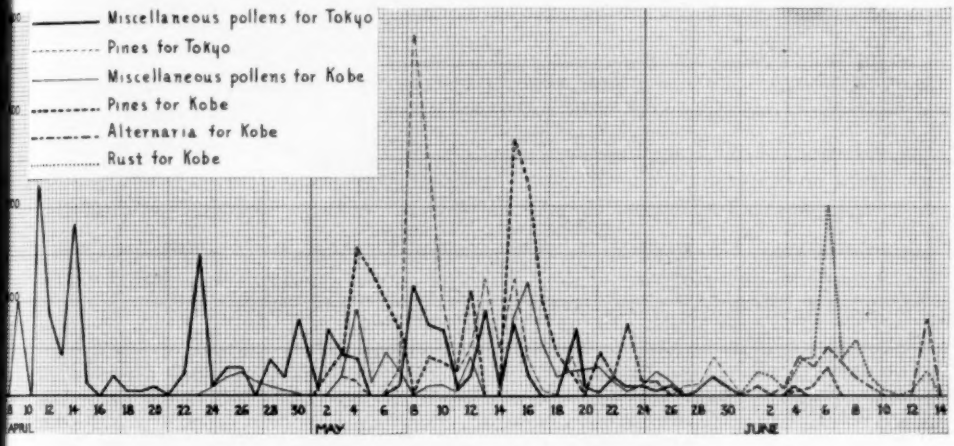

Fig. 3.—Pollen enumeration for Tokyo and Kobe.

nature and character of pollens and fungi encountered on them. They were also submitted to Mr. O. C. Durham, the chief botanist of the Abbott Laboratories, Chicago, for his verification. Unfortunately a number of slides from Kobe were destroyed during the transit from Los Angeles to Chicago, but a sufficient number were left unharmed.

Figure 3 indicates the names and numbers of the pollens on the slides from Tokyo and Kobe. It will be noted that the pollinating season on the main island begins in March. By far the most numerous of the pollens encountered were those of various species of pine, which are abundant all over the island. The pollen of pines has been known to be nonantigenic or only feebly antigenic and to play little or no part in the causation of hay fever. The miscellaneous pollens are not numerically significant. In recent years the importance of fungi in

causing allergic rhinitis has been increasingly recognized by various workers. The number of fungi present is also tabulated.

Comparative Toxicity of Pollens.—In order to test the comparative allergenic potency of Japanese pollens, about 30 Gm. each of the pollens of corn (Zea mays) (fig. 4), lamb's-quarters (Chenopodium album) (fig. 5), common plantain (Plantago major) (fig. 6) and sheep's sorrel (Rumex acetosella) (fig. 7) were obtained through the courtesy of Professor K. Koriba, head of the department of botany of the Imperial University of Kyoto, Japan. (The Japanese pollen was much dehydrated, and photographs are somewhat distorted.) The pollen of the corresponding California plants is shown below the Japanese pollen. Among those not shown in the photomicrographs were specimens of the pollens of orchard grass (Dactylis glomerata) and hog millet (Panicum mileaceum) sent by Prof. Dr. H. Kosakabe, the professor and head of the department of otolaryngology at the Hokkaido Imperial University. Unfortunately these pollens were damaged during transit and could not be used for this study. Each of the pollens from Kyoto was treated with alcohol and glycerin for extraction according to the usual technic of Coca. The pollens of the corresponding six plants of California were treated in similar manner and the exciting principles obtained. This work was done at the Loma Linda Laboratory of Allergy, College of Medical Evangelists, Loma Linda, Calif., under the direct supervision of Dr. Alfred Roos, the allergist in charge. In the course of examination of patients for allergy, when a positive reaction was obtained to an extract of the California pollen another test was immediately made beside it with the Japanese pollen of the same plant in order to compare its potency. This work was done during the season of 1937 and 1938. Only a limited number of patients were so tested, but the results were sufficient to cause me to believe that there is no difference in the local reaction, for even the shape and size of the pseudopods were the same.

Reasons for Absence of Hay Fever in Japan.—Botanic surveys indicate that some plants outstanding among the causes of hay fever in Southern California, such as Bermuda grass (Capriola dactylon), are absent in Japan. Ragweed, though unknown up to recent years, is said to be coming into the country, but it is certainly a much less important factor in Japan than in California. However, there are almost equally important plants, such as cultivated and wild oats (Avena sativa and Avena fatua), cultivated barley (Hordeum vulgare), cultivated wheat (Triticum vulgare), annual blue grass (Poa annua), lamb's-quarters (Chenopodium album) and sweet vernal grass (Anthoxanthum odoratum).

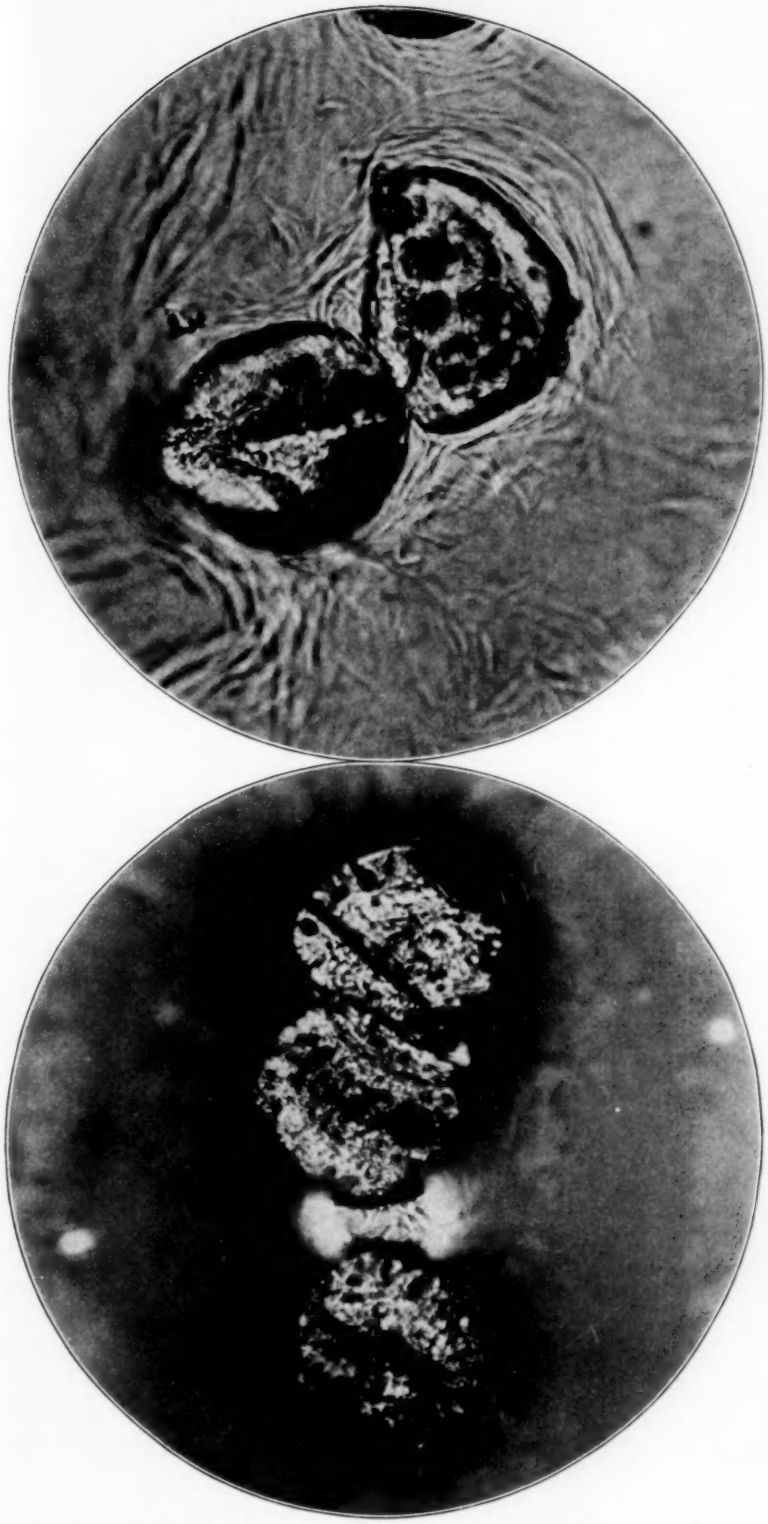

Fig. 4.—Japanese (above) and California corn (Zea mays) ; × 360.

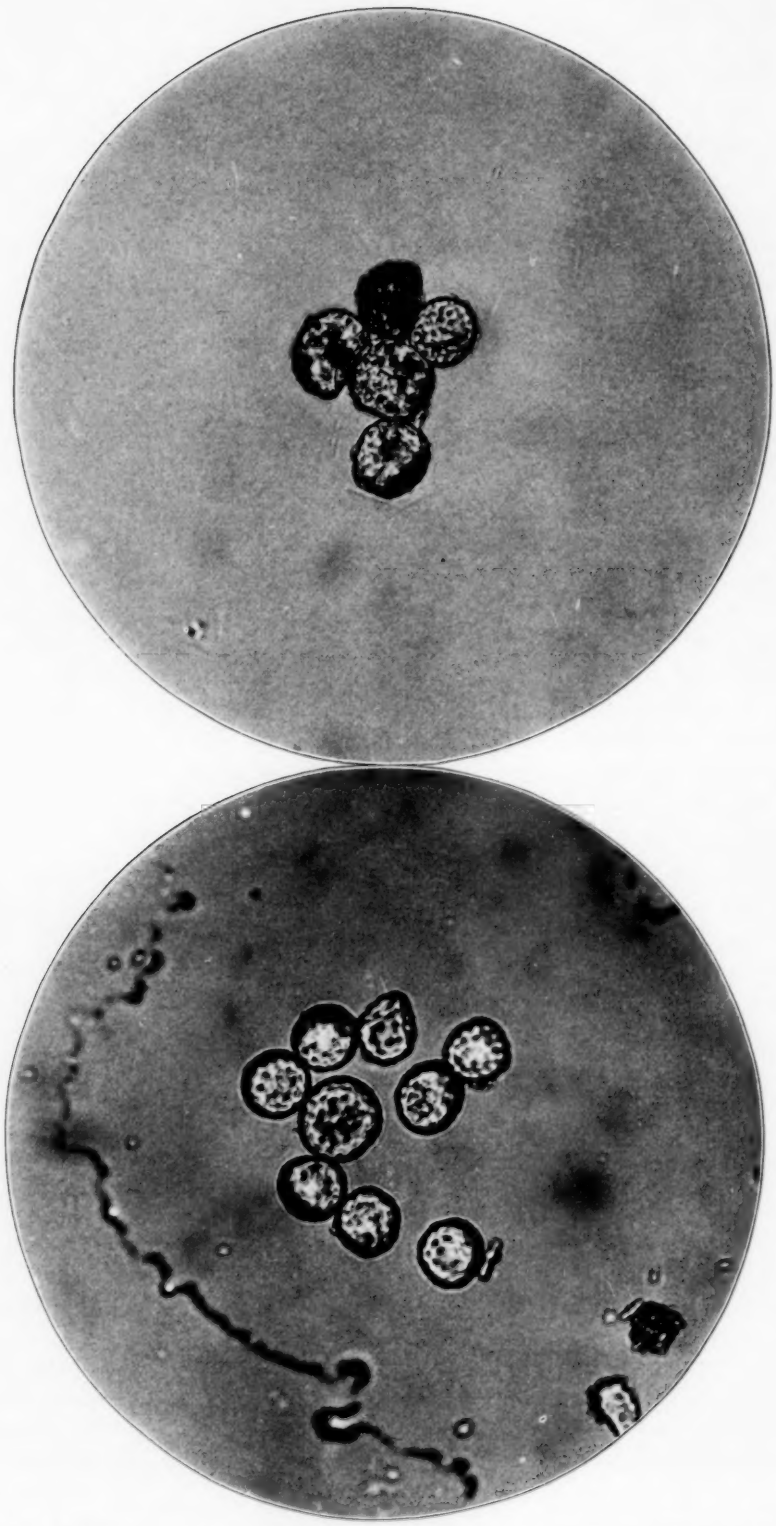

Fig. 5.—Japanese (above) and California lamb's-quarters (Chenopodium album); × 360.

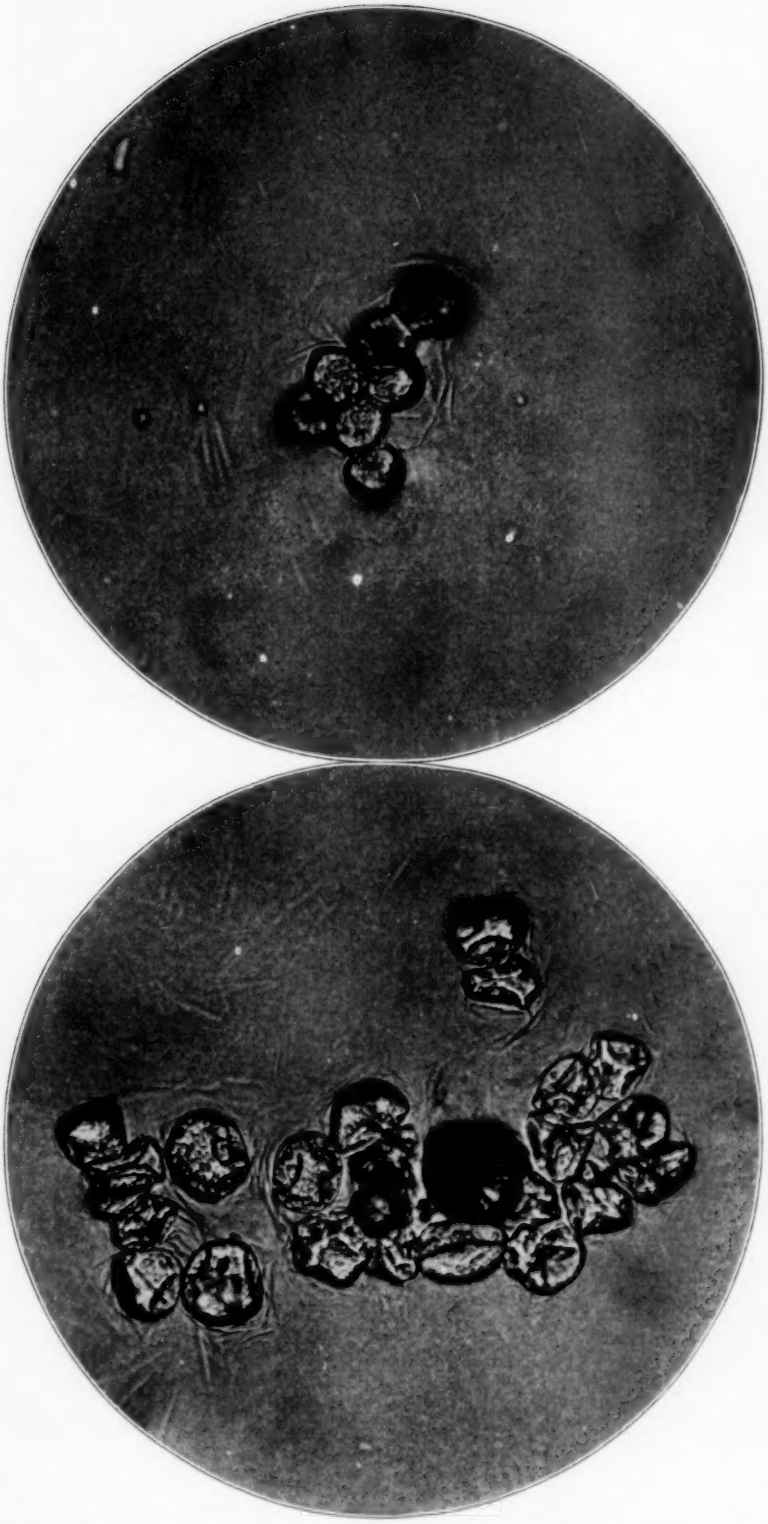

Fig. 6.—Japanese (above) and California common plantain (Plantago major); × 360.

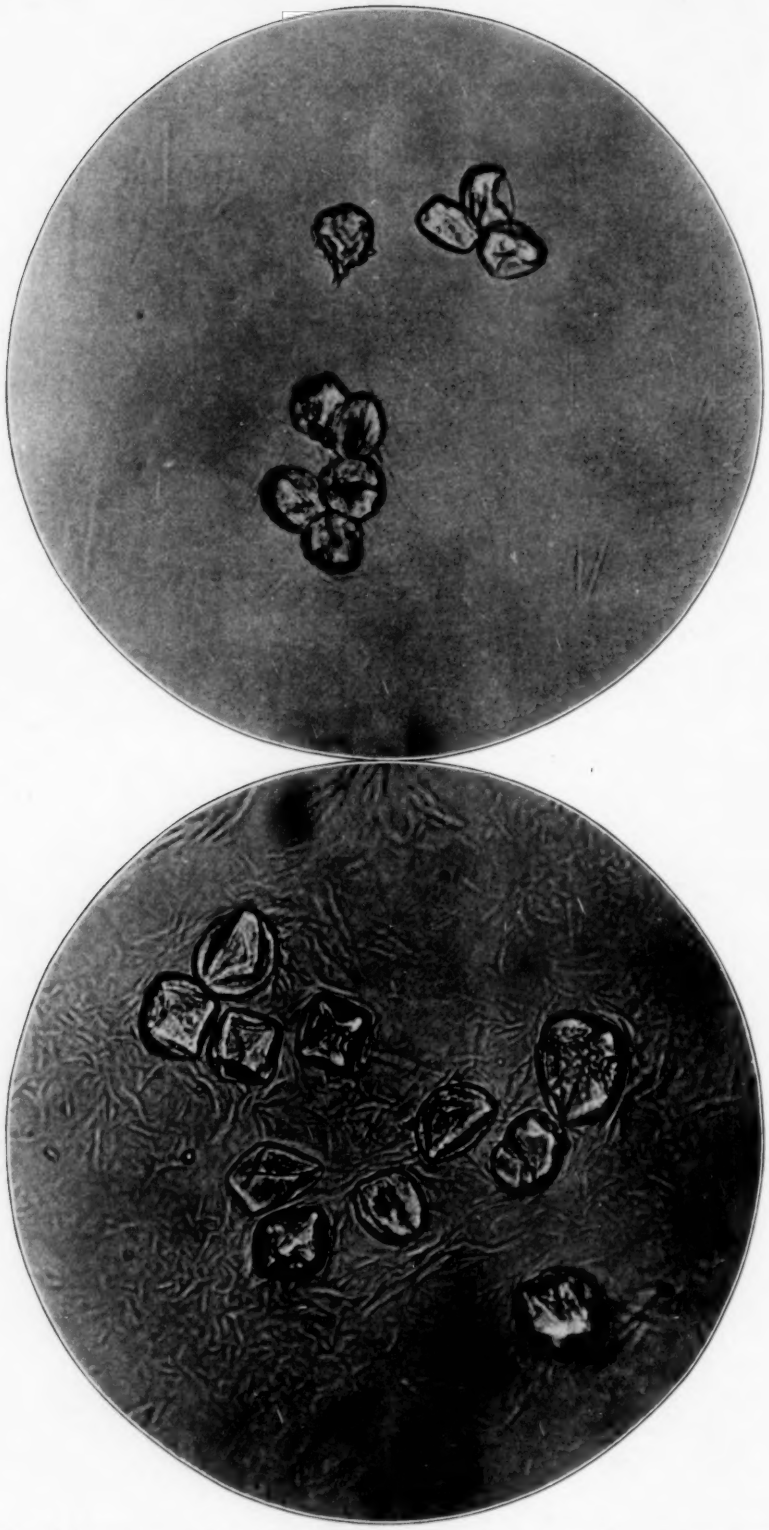

Fig. 7.—Japanese (above) and California sheep sorrel (Rumex acetosella); × 360.

According to a statement in the *Japan Times'* year book of 1938, the flora of Japan consists of about 17,087 species, classified as follows:

Flowering plants	9,000
Ferns	700
Mosses	2,000
Fungi	3,500
Lichens	700
Marine algae	691
Freshwater algae	323
Mycetozoa	173

Favored by rich soil, high temperature and abundant rainful well distributed, through the year, the Japanese islands boast of an unusually luxuriant growth of plants and vegetation. But for the propagation of a large quantity of buoyant wind-borne pollen for any distance the meteorologic condition of the country appears to be wholly unsuited.

Study such as that herein described clearly indicates the presence of pollens capable of causing hay fever, but the quantity of such pollens is so small that the atmosphere is comparatively free from them and the chain is thus broken.

As was pointed out by Durham,[3] it is not beyond the limit of probability that in the previous study, on pollens from Sapporo, some of the fungi might have been inadvertently included in the pollen enumeration and an impression thus given that the air in Sapporo is rich in pollen. Unfortunately those slides have been destroyed. In the present study I have taken every precaution to avoid every source of technical error, and the figures presented here approach much more accurately the numbers of the pollens encountered. In these days of rapid yet comparatively inexpensive transportation, American sufferers from hay fever may find it convenient to visit Japan and enjoy complete freedom from this perennial disorder.

436 South Boyle Avenue.

3. Durham, O. C.: Hay Fever Among the Japanese, Arch. Otolaryng. **23**:121 (Jan.) 1936.

VERTIGO

CLINICAL CONSIDERATION

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With the more frequent employment of the labyrinthine or vestibular tests, the symptom vertigo has gradually become associated with otologic problems. Up to this time, the symptom, being somewhat of a cerebral sensation, has been classed with neurologic symptoms.

With the labyrinthine tests signs suggestive of an intracranial lesion are not only frequently pointed out but such a lesion is occasionally diagnosed some time before neurologic signs are clinically apparent. For this reason and because of the direct association of vertigo with internal disturbances of the ear, patients suffering from this symptom are referred to the otologist for consideration. For instance, a physician who had become subject to attacks of vertigo consulted his medical attendant and neurologist. His great concern was as to duration of his life or the possibility of permanent disability. He was about to undertake some changes in his plans requiring considerable financial investment and was uncertain as to his future physical ability to meet these changes. It was feared that he might possibly have a tumor of the brain. The labyrinthine tests during and between his attacks definitely excluded the probability of such a lesion and even pointed to some actual irritation of one of his labyrinths, which could in time be eliminated. He went ahead with his plans, and the future events justified this conclusion.

Frequently, one is called on to determine the justification of claims for compensation because of vertigo persisting after a head injury during the course of employment, as persons making such complaints are often suspected of malingering. The same situation arises during suits for damages in automobile accidents. Such persons as well as those with otologic conditions in whom vertigo develops come to the consideration of the otologist. The labyrinthine tests in all instances are of prime importance. There is only one answer to the problem. One

Read before the Columbus Society of Ophthalmology and Otolaryngology Dec. 5, 1938.

From the Department of Neuro-Otology, Graduate School of Medicine of the University of Pennsylvania and the Department of Otolaryngology School of Medicine, University of Pennsylvania, service of Dr. George M. Coates.

must become acquainted with the symptom and its variations as well as with the value and employment of the labyrinthine tests.

DEFINITION

Vertigo is a subjective sensation of disturbed equilibrium often accompanied by a slight obscuration of consciousness. It may be manifested in the form of (1) giddiness, which is a mild degree of fainting with a momentary loss of one's balance; (2) sense of rotation, e.g., a sense of objects rotating about a person or of the person rotating about objects, and (3) pulsion, a veering of a person to one side or the other. All the foregoing sensations appear in the form of attacks; they are not continuous or constant.

Because of the various manifestations of the sensation, vertigo has been given various definitions. A common one is that it is an unpleasant sensation arising from one's feeling of a disturbed relation to surrounding objects in space. Hughlings Jackson described vertigo as "a sensation of motor origin resulting from a discord between the impressions which come from the labyrinth, the cerebellum, eye muscles and from other sources with which they coordinate or act in harmony. As a result of the discord of these impressions consciousness is affected with a distressing sensation known as vertigo." In other words, the symptom is due to disharmony in the organs of equilibrium. The subject is of interest to internists, otologists, neurologists and ophthalmologists, since this symptom is confronted in diseases related to these fields of medicine.

The symptom cannot be considered in the light of any one of these specialties alone to the exclusion of the other. Its character cannot be exclusively defined as belonging to one category or another. It is, therefore, deemed advisable to present a generalized view of the subject and to differentiate the condition when possible.

EQUILIBRIUM

Equilibrium is maintained by the cooperation of several factors: (1) afferent impulses to the brain, (2) efferent impulses through the motor tracts to the muscles and (3) coordinating centers in various parts of the brain.

The afferent impulses come from (*a*) superficial and deep sensibilities located in the skin, muscles, tendons and joints; (*b*) visual impressions, and (*c*) the vestibular portion of the internal ear.

Skin, Muscle and Joint Sense.—Experiments on frogs whose cerebrums have been removed but who have optic lobes and cerebellums show that the animal can still maintain equilibrium satisfactorily, but when the hindlegs are skinned it falls like a log. It lacks the sense of touch necessary to maintain equilibrium (Ferrier). A man whose

soles are frozen with ethyl chloride has difficulty in maintaining equilibrium when his eyes are closed. A person with locomotor ataxia will fall over when he is deprived of his visual factor of equilibrium, because of the interference with the pathways carrying sensory impressions from the skin and muscles and joints due to sclerosis of the posterior columns of the spinal cord. He falls when his eyes are shut (Romberg sign).

Visual Impressions.—While one born blind can finally coordinate motion and equilibrate, vision is a great help in learning to walk. A person sees objects around him and coordinates movements accordingly. One learning to walk looks at his feet and gets along better. After movements become automatic, the eyes are not so necessary, but still one equilibrates better when one's eyes are open and one sees. For the person with locomotor ataxia whose tactile sense is impaired, vision is important to maintain equilbrium. Even for the blind person with locomotor ataxia the steady gaze of the open eyes often is of some value.

Vision is important in equilibration, and this importance is illustrated by the creation of unusual movements in the field of vision, by moving objects and by faulty oculomotor apparatus. These factors impair one's association of the relative positions of objects in space. The disturbance of these relations in the mind creates a sense of vertigo, e. g., gazing at a moving object, nystagmus and erroneous projection on the retina cause distressing vertigo. Cyon caused disturbance of equilibrium in pigeons by putting prisms in front of their eyes.

While vertigo may result from some types of refractive errors, it is most manifest in those conditions in which stereoscopic vision is interfered with, e. g., muscle imbalance and diplopia.

Labyrinthine Function.—This function is the most important factor for maintaining equilibrium in everyday life. The semicircular canals are the external organs which detect change of one's position in the various complicated movements of the body. The utricle and saccule detect change of movements in a straight line up and down or from side to side. The latter is supposed to be the function of the utricle, while the saccule is supposed to detect motion vertically.

Experiments on the labyrinth date back to about 1824, when Florenz actually started the study of neuro-otology with the experiments on the semicircular canals of pigeons. He noted that when a horizontal canal was destroyed there was a lateral movement of the head with rotation of the body in the horizontal plane. When the posterior canal was obliterated, the head waved back and forth with a tendency to fall back. When the anterior canal was thus experimented on, the pigeon fell forward. Florenz thought that the canals controlled body movements and did not realize that he had opened a field for the study of equilibrium. His observations were confirmed, but interpretations were confusing.

In 1825 Purkinji recorded observations on other animals and also studied the concomitant movements of the eyes. Experiments on frogs by various observers (Goltz, Ferrier and others) pointed to the connection of the canals with vertigo.

In 1869 Goltz advanced the theory that currents in the endolymph caused the stimulation in the canals.

In 1875 Mach, Breuer and Crum-Brown expressed the belief that partial pressure to or away from the ampulla caused the stimulation.

In 1892 Ewald showed that there was a difference in displacement of the head when the current was toward the ampulla or away from the ampulla.

In 1891 Breuer expressed the belief that the function of the otoliths is to sense the position of the head in space, since they are placed in two planes and their action depends on gravity.

Byrne in 1912 stated that pressure in the canals more logically explains stimulation than movements of current.

In 1892 Ewald drilled a hole in the posterior part of each of the semicircular canals and filled them with lead to block the flow of current at that end. A tubule was inserted in an opening in front of the first hole and a rubber bulb was connected with it, so that suction and pressure could be applied at will, to or away from the ampulla. The following conclusions were reached in regard to stimulation of the centers through the end organs: 1. A current toward the ampulla in the horizontal canal caused greater stimulation than when drawn from the ampulla. 2. The reverse was true in the vertical canal. A current away from the ampulla in the vertical canal caused the greater stimulation. 3. The eyes and head moved in the plane of the canal stimulated.

According to Hoyge's law, when the vestibular end organ of one side is stimulated, it causes contraction of the abductor ocular muscles on the opposite side and the adductor muscles on the same side, e. g., conjugate deviation, or the slow component of the eyes is away from the side being stimulated.

Hoyge in 1890 recorded a systematic study of the internal ear, including the foregoing law. From that study Bárány, Neuman, Rutin, Alexander and Kreidel got ideas for further study. In 1905 Bárány observed that douching of a suppurating ear with water that was too cold or too hot induced vertigo and a definite type of nystagmus. He found the same reaction in normal persons, and this was the beginning of the caloric test.

In 1909 Cajal demonstrated histologically the connection of the vestibular apparatus with the cerebellum by means of the horizontal canal. Later studies were made by Jones, Fisher, Weisenburg and Mills.

Eugene Lewis studied the mechanics. Shambaugh demonstrated the existence of more hair cells on one side of the crista ampularis than on the other.

The development of the routine tests is based on these studies. If one visualizes the anatomic location of the semicircular canals, all of the reactions to the various tests can be explained by these laws. The principal anatomic points to bear in mind are: (*a*) The horizontal canals are in an almost horizontal plane (made horizontal by tilting the head 30 degrees forward). (*b*) The ampullae are on the anterior aspect. Therefore, when a person is rotated to the right (clockwise) the current will be made to flow to the patient's right—on the left side toward the ampulla and on the right side away from the ampulla, after rotation ceases.

1. Cold caloric douching will not affect the canals in the horizontal plane, but when the head is tilted back the chilled fluid will fall by gravity downward; when the right ear is douched it will fall to the right in a clockwise direction, away from the ampulla. With the head tilted forward, the current will flow toward the ampulla, anticlockwise and to the patient's left.

2. The vertical canals are so placed that the anterior ones are directed outward and forward 45 degrees to the sagittal plane of the head as well as to the coronal plane. The ampullae are placed forward. The posterior vertical canals are placed in a similar relation to the planes of the head but directed backward and outward. The anterior canal on one side is parallel to the posterior canal on the opposite side.

Cold caloric douching of the right vertical canal will cause the current to flow outward, downward and to the right in both canals on the side tested, toward the ampullae.

Rotation with the head 90 degrees forward will give an opposite reaction to that with the head backward. In each instance the vertical canal on each side is placed in a semihorizontal plane. With the head forward, when the patient turns to the right the current in all canals will flow clockwise, to the right in the front part of a circle. On the right side it will flow toward the ampullae and on the left side away from the ampullae. With the head 60 degrees back, when the patient turns to the right the current will flow clockwise in all canals but to the left in the back part of a circle with reference to the patient. With the foregoing positions in mind, all usual reactions, as appended in tables 1 and 2, can be explained. It is, of course, only necessary to know the routine normal responses in order to differentiate them from the abnormal responses.

All factors are not absolutely necessary to maintain equilibrium satisfactorily, but at least two are necessary for the purpose. When one factor is interfered with, the others compensate and carry on the func-

TABLE 1.—*Responses to Bárány Tests of the Vestibular Apparatus (Routine)* *

Rotation Tests	
1. Spontaneously	1. No nystagmus, vertigo, past pointing or falling
2. Turn patient to the right 10 times in 20 seconds; head 30 degrees forward	2. Horizontal nystagmus to left, 24 seconds in duration
3. Turn patient to the left 10 times in 20 seconds; head 30 degrees forward	3. Horizontal nystagmus to right, 24 seconds in duration
4. Turn patient to the right 10 times in 10 seconds; head 30 degrees forward	4. Past pointing to right with each hand, about 12 inches (30 cm.)
5. Turn patient to the left 10 times in 10 seconds; head 30 degrees forward	5. Past pointing to left with each hand, about 12 inches
6. Repeat tests 4 and 5 and ask patient (whose eyes are shut as they should be in all these tests) to say repeatedly in which direction he is turning, e. g., right or left	6. Patient will feel himself turning in direction of rotation while turning; when chair is suddenly stopped he will think he is turning in opposite direction for 26 seconds —indicates normal quantitative vertigo

For the rotation tests the eyes should be closed and the horizontal canals only are tested; both sides are tested at the same time. The vertical canals are not usually tested by this method, although that can be done by repeating these tests with the head in such a position as to bring the canals into a nearly horizontal plane, e. g., 90 degrees forward or 60 degrees backward. Reactions will take place accordingly.

Caloric Tests (Mass Irrigation with Water, 68 F.)	
1. Douche the right ear with water 68 F.; head 30 degrees forward; note length of time required to produce reaction	1. Requires about 40 seconds of douching; nystagmus will be rotary to left; past pointing will be about 8 inches (20 cm.) to right with each hand; patient will have a sensation of turning (vertigo) to left and tendency to fall to the right
2. After results of first caloric test have been quickly noted, bend the head back 60 degrees and again note reactions	2. Same response as with test 1, except nystagmus is horizontal
3. Repeat tests 1 and 2 in left ear	3. Same response as with tests 1 and 2 but in opposite directions

The caloric method tests each ear, as well as the vertical and horizontal canals, separately. When the head is inclined 30 degrees forward, the vertical canals are tested; when it is inclined 60 degrees backward, the horizontal ones are tested. Sometime during the course of these tests, varying in degree with each patient, there is a certain amount of shock, pallor, nausea and perspiration, which is a normal reaction of the sympathetic nervous system.

Caloric Test (Kobrak Method); Minimal Stimulation

This method has been variously modified. One may take as a standard the use of 5 cc. of water at 55 F. and inject it with a syringe against the upper posterior part of the drum. Normally there is a latent period before the nystagmus appears, about 15 to 25 seconds. The duration of nystagmus is 60 to 100 seconds. The nystagmus is the same as with mass caloric douching; vertigo and past pointing are mild or are absent. If no reaction occurs, the quantity of water used is doubled after waiting awhile. It may thus be repeated several times, each time increasing the quantity of water. The labyrinth is said to be hyperactive when the nystagmus appears in less than 15 seconds or lasts longer than 100 seconds. It is said to be hypoactive when the latent period is prolonged or the duration is shortened or larger quantities of water are required to bring on the reaction. In cases of hypoactive labyrinths the temperature of the water used may also have to be lowered to that of ice water. Perversions and inversions of nystagmus can also be elicited by this method.

Galvanic Method

A galvanic plate is used (direct current), or special batteries, having a positive pole (anode) and a negative pole (cathode) are employed. With the bipolar method one pole is applied to each ear, so that only 1 or 2 milliamperes of current is used. The nystagmus produced is in the direction of the flow of the electric current, which is from the positive to the negative pole. When the positive pole is applied to the right ear there is a rotary nystagmus to the left, vertigo to the left and falling and past pointing to the right (same as with cold caloric test). Changing the position of the head backward or forward makes no difference. The unipolar method is more satisfactory; the positive electrode is applied to the tragus and the other pole to a distant part. In this manner more current, 4 milliamperes, is required. If less current is required, the labyrinth is said to be hyperactive; if more current is required, it is said to be hypoactive. The reaction is present even when the labyrinth is not functioning—through the eighth nerve, if that is not degenerated, as in a recently destroyed labyrinth.

If all the responses are present, either normal or more or less proportionately exaggerated or diminished, it means that both inner ears are intact, that there probably is not present any lesion in either of the cerebellopontile angles and that if any vertigo exists it is probably due to some external cause, e. g., toxic irritation of the labyrinth, focal infection in the tonsils, teeth, kidneys, gallbladder or gastrointestinal tract.

* The rotation test does not disturb the patient so much as the caloric method, and both labyrinths are tested at the same time. The caloric method causes sickness of the patient, but one side alone can be tested. The Kobrak method is a good method because it does not disturb the patient as much as the mass caloric method and tests one ear at a time, but the study of vertigo and pointing is not as satisfactory.

TABLE 2.—*Normal Vestibular Reactions in Various Planes* *

Rotation Tests	Nystagmus†	Vertigo	Past Pointing	Falling
		Rotation		
Turn to right; head 30° forward	Horizontal to left	To left in horizontal plane	To right	.....
Turn to left; head 30° forward	Horizontal to right	To right in horizontal plane	To left	.....
Turn to right; head 60° back	Rotary to right	To left in horizontal plane and sensation of falling to right when head is brought up	To right	To left on getting up
Turn to left; head 60° back	Rotary to left	To right in horizontal plane and sensation of falling to left when head is brought up	To left	To right on getting up
Turn to right; head 90° forward	Rotary to left	.....	.....	.....
Turn to left; head 90° forward	Rotary to right	.....	.....	.....
Turn to right; head 120° forward	.....	To left in horizontal plane and sensation of falling to left when head is brought up	To right	To right on getting up
Turn to left; head 120° forward	.....	To right in horizontal plane and sensation of falling to right when head is brought up	To left	To left on getting up
Turn to right; head to right shoulder	Vertical down	.....	Up when head is brought up	Backward on getting up
Turn to left; head to right shoulder	Vertical up	.....	Down when head is brought up	Forward on getting up
Turn to right; head to left shoulder	Vertical up	.....	Down when head is brought up	Forward on getting up
Turn to left; head to left shoulder	Vertical down	.....	Up when head is brought up	Backward on getting up
Turn to right; after head is turned 45° to right and inclined to right shoulder 90°	Oblique down to left when head is brought up	.....	.....	.....
Turn to right after head is turned 45° to left and inclined to right shoulder 90°	Oblique down to right when head is brought up	.....	.....	.....
Cold water, 68 F.				
Douche right ear; head 30° forward	Rotary to left	Sense of falling to left	To right	To right
Douche left ear; head 30° forward	Rotary to right	Sense of falling to right	To left	To left
Douche right ear; head 60° back	Horizontal to left	Sense of falling to left	To right	To right
Douche left ear; head 60° back	Horizontal to right	Sense of falling to right	To left	To left
Douche right ear; head 120° forward	Horizontal to right	Sense of falling to right	To left	To left
Douche left ear; head 120° forward	Horizontal to left	Sense of falling to left	To right	To right
Hot water, 112 F.				
Douche in same positions as with cold water	Opposite to that with cold water	Opposite to that with cold water	Opposite to that with cold water	Opposite to that with cold water

* These reactions are in accordance with the following physiologic laws: 1. The eyes are always drawn (slow component) in the direction of movement of the endolymph (nystagmus opposite). 2. Vertigo is always in a direction opposite to the movement of the endolymph. 3. Past pointing is always in a direction opposite the vertigo. 4. Falling is always in a direction opposite to the vertigo.

† The description indicates the direction in relation to the patient.

tion. For this reason a blind man can maintain his balance with the aid of his labyrinths, his muscle and joint sense and his sense of touch. A person with tabes whose eyes and labyrinths are intact but not his spinal pathways will maintain his equilibrium with his labyrinthine and visual functions. When he closes his eyes, he falls. A deaf-mute having no labyrinthine function maintains his equilibrium with his remaining functions. Sudden ablation of the labyrinth by disease will cause unpleasant vertigo for a while, but compensation takes place and the patient will get along.

Jones and Ocker showed that human beings are more capable of detecting motion and change of motion in a dark elevator when the vestibular apparatus is normal. They also pointed out that in blind flying pilots make considerable use of their vestibular sense. This emphasizes the importance of the vestibular apparatus.

PROBABLE PATHWAYS OF VERTIGO

Jones postulated separate vertigo tracts running from the internal ear to the brain. On the basis of clinical manifestations in certain cases as demonstrated by vestibular tests, he found that there must be separate pathways carrying vertigo impulses as follows: (1) a group of fibers from the horizontal semicircular canals to the vestibular nuclei, (2) group of fibers from the vertical canals to these nuclei, (3) fibers from the horizontal canals to the cerebellar nuclei through the restiform body (inferior cerebellar peduncle), (4) fibers from the vertical canals to the cerebellar nuclei through the middle cerebellar peduncle (brachium pontis) and (5) all the fibers from the cerebellar nuclei, which cross to the opposite temporal lobe by way of the superior cerebellar peduncle (brachium conjunctivum).

Spiegel and Alexander, after experimenting on animals and observing and studying recorded cases of tumor of the brain, found that the temporal lobes particularly and also parts of the frontal lobes (centro-opercular region) are the seat of vertigo perception. None of the pathways have been proved histologically.

ETIOLOGY

Normally the greatest factor in maintaining equilibrium is the internal ear. Tonus impulses are sent to the skeletal muscles, which are equal on each side. There may or may not be definite tracts in the brain carrying these impulses from the labyrinth to the brain and to the muscles. As long as both internal ears and other pathways are intact, equilibrium is maintained. Any deviation caused by irritation or destruction of any normal factors concerned in maintaining equilibrium results in vertigo.

The etiologic factors which produce vertigo are considered in four groups.

1. General systemic conditions, such as cardiac disease, renal disease, arteriosclerosis, pernicious anemia and leukemia, which arise from disturbance of the labyrinthine circulation, e. g., anemia, hyperemia or actual hemorrhage into the labyrinth, may cause vertigo. Nitrogen embolism is the cause of vertigo in caisson workers. Drugs like quinine and the salicylates, tobacco, infections due to diseased teeth, tonsils and sinuses, inflammations of the gastrointestinal tract, including foci of infection anywhere in the tract as well as in the gallbladder or the colon, and even dietetic errors can cause vertigo. Patients have been relieved of vertigo by removal of such foci and by attention to the gallbladder, bowels and dietetic errors (excessive proteins and sugars).

2. Ocular conditions, principally muscle imbalance, produce this symptom.

3. Diseases of the ear also give rise to vertigo.

4. Diseases of the brain are an etiologic factor.

Among the general conditions causing vertigo may be included faulty water metabolism causing a waterlogging of the internal ear and also an excess of sodium in the body. Vertigo in such cases can be controlled by reduction of the sodium intake in the diet and the administration of massive doses of ammonium chloride, an acid-forming salt which prevents retention of sodium in the body.

Ocular conditions causing vertigo are chiefly those of muscular imbalance. Vertigo is most marked when the patient looks in the direction of the paretic muscle. It disappears when the eyes are closed and diminishes when the eyes are turned from the side of the paretic muscle. Any cause producing diplopia will produce vertigo. Poorly adjusted glasses, particularly on persons who are beginning to wear bifocal lenses, will cause vertigo. Correction of this factor relieves the vertigo.

A personal communication from Dr. Edmund B. Spaeth concerning the status of vertigo in patients coming to the ophthalmologist for the relief of this symptom, gives the following data:

(*a*) The ocular condition which is commonly the cause of vertigo is that of muscle imbalance. Hyperphoria comes first, exophoria second and esophoria last. Vertigo is present even though no true diplopia is noted by the patient. Naturally frank diplopia from paralysis of an oculomotor nerve is an outstanding cause of vertigo.

(*b*) In the case of diplopia the wearing of a patch over one eye is necessary. In the case of hyperphoria correcting prisms should be worn, or if the hyperphoria should be the result of paralysis of a levator muscle, the treatment should be surgical. In double hyperphoria, vertigo is rather less common. In exophoria prism exercises are of outstanding value. In esophoria orthoptic exercises with the stereoscope are of value.

(*c*) The type of vertigo or the sensation of which the patient usually complains is that of dizziness, unsteadiness and usually squeamishness on arising in the morning. The patient with vertigo seems to move rather than the outside world moving about him. The symptoms are always aggravated by fatigue, even though the vertigo may have originated with the use of the eyes. Such patients are remarkably susceptible to fatigue and do not stand concerted effort well.

Aural conditions causing vertigo are as follows:

1. In the external auditory canal foreign bodies or otitis may cause vertigo by increasing labyrinthine pressure or irritation of the ear drum.

2. In the middle ear catarrhal otitis media and blocking of the eustachian tube may cause vertigo, which is relieved by inflation. Suppuration of the middle ear, either acute or chronic, may cause vertigo through infection of the labyrinth. Mild vertigo in the presence of chronic suppurative otitis media is a symptom calling for proper attention to the ear. It is an indication of perilabyrinthitis, and an actual attack of labyrinthitis or intracranial invasion by the infection is threatened. Sudden onset of vertigo, nausea and vomiting associated with nystagmus, ataxia and deafness in the presence of a suppurating ear are the manifest signs of an actual invasion of the labyrinth by infection. When vertigo is a prominent symptom in cases of chronic suppurative otitis media with signs of intracranial invasion, the cerebellum may be the organ involved. A sudden onset of the foregoing group of symptoms of labyrinthitis without the presence of suppuration has been described by Ménière as due to a hemorrhage into the labyrinth. This syndrome has been, since his description, called Ménière's disease. He was the first to call the attention to the fact that this group of symptoms was due to disease of the inner ear. Many causes acting on the inner ear have since been found to produce this symptom complex. All the causes of vertigo enumerated under general conditions causing vertigo have been described by this name.

Intracranial lesions causing vertigo may be tumors in the frontal or parietal lobes as well as in the cerebellum. Weisenburg, in a study of a number of cases of tumor of the brain with reference to vertigo, concluded that vertigo is caused by a great increase in intracranial pressure and that tumors of the posterior fossa are therefore more likely to cause vertigo. He found that no characteristic type of vertigo was caused by any type of tumor and that tumors may exist without causing vertigo. Lesions must involve the vestibular tracts by destroying them. Gliomas do not destroy these fibers.

Trauma to the head is often followed by vertigo for a long time and is probably due to concussion of the brain. This is of importance in industrial cases in which, following trauma, a person claims compensation for disability caused by vertigo. Persons with such injuries are often suspected of malingering. Vestibular tests, however, give some inkling as to the reliability of their claims.

Many persons with vertigo show some hypoactivity or hyperactivity, while some show actual signs of intracranial involvement, such as lesions of the cerebellopontile angle. This may be due to petechial hemorrhages of the brain, as shown by Bruner in experimental trauma of the head of animals.

Vertigo is difficult to differentiate as being caused by one lesion or another. In general, it may be said that rotational vertigo is associated with aural lesions. The patient with the severe form feels a sense of rotation of objects around him or he around the objects. This symptom is usually associated with a vestibular type of nystagmus (slow and quick component) and becomes worse when the eyes are directed toward the side of the quick component. Deafness, nausea, vomiting and ataxia, occur and the patient manifests a tendency to rotate or fall in a direction opposite the quick component of the coexisting nystagmus. The symptom has a tendency to subside within ten days or two weeks. This constitutes the picture of labyrinthitis when suppurative otitis media is present. This picture is also true in cases of Ménière's syndrome in which no suppuration of the ear is present. In cases of a milder nature the attacks of vertigo appear in spells, and the characteristics are the same, except that they are milder in degree. When a patient is seen during an attack of vertigo, the facts concerning an irritable labyrinth should be helpful. An irritable labyrinth causes the eyes to deviate (conjugate deviation) to the opposite side, with resultant nystagmus (quick component) to the affected side. The ataxia or tendency to fall will be toward the opposite side (opposite the quick component). When the vestibular tests are being performed, patients frequently volunteer the information that the reactions simulate their attacks.

If these facts can be elicited, they point more definitely to a labyrinthine irritation. This is true regardless of the irritant, whether it is toxic, circulatory or aural. Such an irritation would less likely be due to an intracerebral condition.

It is said that with certain conditions of the brain, such as multiple sclerosis or encephalitis there may be a form of vertigo described as lateropulsion, a sensation of being pushed to right or left. The characteristics of the vertigo associated with each condition, however, are not sufficiently constant to be clinically of differential value.

DIAGNOSIS

Diagnosis of the cause of the vertigo must be made only after complete physical examination to determine the presence of cardiac or circulatory disturbance, renal disease or disease of the gastrointestinal tract and neurologic examination to detect any cerebral disease. A focal

infection must be borne in mind as important. Another important measure in the diagnosis is the performance of the vestibular tests.

These tests may be the only clue to the existence of an intracranial lesion. They may indicate by hyperactivity or hypoactivity the presence of some focal infection or provide an objective proof of some intracranial traumatism in a patient suspected of malingering. It is felt that the vestibular tests are of the utmost importance in the study of vertigo, and a brief outline is given in table 3 together with probable interpretations.

TREATMENT

Treatment consists of finding the cause and eliminating it when possible. Tumors of the brain are, of course, neurosurgical problems. When

TABLE 3.—*Principal Abnormal Vestibular Responses for Diagnosis and Localization of Intracranial Lesions*

Spontaneously 1. Vertical nystagmus 2. Horizontal nystagmus to one side 3. Poor movements of pelvic girdle	**Lesions of the Posterior Fossa** 1. No sensitivity to tests 2. General depression of reactions 3. Lesion usually on side of depression or other abnormality 4. When both sides show abnormalities, lesion usually in midline
After Testing 1. Perverted nystagmus (*a*) Oblique nystagmus (*b*) Vertical nystagmus (*c*) Horizontal instead of rotary nystagmus and vice versa 2. Inverted nystagmus 3. Large amplitude of nystagmus 4. Small rapid ocular movements 5. Dissociated ocular movements 6. Conjugate deviation	**Supratentorial Lesions** 1. Usually marked sensitivity to tests 2. Usually exaggerated responses 3. With lesion of the midline—similar involvement of each side 4. With interference with vertical canal—lesion usually on the opposite side 5. With perverted response of horizontal canal to caloric test—lesion on the same side 6. Conjugate deviation usually to side of lesion
	Syndrome of Lesion of Cerebellopontile Angle 1. Loss of function on the affected side, including hearing 2. Impaired responses from vertical canals and probably perverted responses from the horizontal canal on the opposite side 3. Both 1 and 2 may be present

an intracranial lesion has been excluded by neurologic and by vestibular examination, the problem resolves itself into finding and eliminating other causes. In the presence of a discharge from the ear, particularly a chronic one, this would be the most likely cause of trouble. Perilabyrinthitis is a frequent cause of recurring attacks of vertigo, and radical mastoidectomy often affords relief. Severe attacks of vertigo and ataxia in association with either acute or chronic otitis media point to a possible labyrinthitis or cerebellar abscess and should be treated as indicated.

Patients have been relieved of vertigo by removal of infected teeth and tonsils and by proper treatment of a diseased sinus. Gastrointestinal

disturbance and disease of the gallbladder have proved to be frequent offenders. Dietetic irregularities should be corrected. Circulatory disturbances in persons past middle age are often the cause. Reduction in activities and avoidance of overeating correct these conditions. Anemia and low or high blood pressure should be corrected.

When one fails to discover and eliminate probable causes, there are methods of symptomatic treatment which have offered relief. One method is a medical treatment recommended by Furstenburg and his co-workers, that is, reduction of the sodium content of the body. Dedring and Mygind insist on the additional importance of water-logging of the labyrinth as a potent factor in the production of vertigo and advise a reduction of fluid intake.

The treatment consists in the reduction of salt intake in the diet, reduction of fluid intake and the administration of large doses of ammonium chloride three times a day. General care of the patient's health, e. g., the anemia, bowel irregularities, etc., is an important adjunct to the special treatment. Three grams of ammonium chloride are taken with each meal in capsules (six capsules each containing 7½ grains [0.492 Gm.] of ammonium chloride). This is given for three days and then omitted for two days. It may be continued indefinitely without untoward effect but with relief from symptoms.

Another method is recommended by Dandy. It is the surgical severence of the vestibular portion of the eighth nerve. While it is a simple operation in his hands, it really is a formidable procedure and should be resorted to only as a last resort. It must be borne in mind that there are patients who were almost ready to submit to this operation but hesitated and were finally relieved by some medical form of treatment. It should be looked on as a palliative measure and not a cure for the condition. Vertigo is not a disease of the eighth nerve comparable to neuralgia of the fifth nerve. Vertigo with its associated symptoms of nausea and vomiting form part of the so-called Ménière's syndrome and is a manifestation of various conditions.

Injection of a solution of formaldehyde into the inner ear has also been recommended.

Surgical trephination of the saccus endolymphaticus has been advocated by Portmann, and Mosher has proposed opening the superior semicircular canal in the middle fossa and packing it. The vestibular function of the labyrinth is thus destroyed.

CLIMATIC FACTOR IN MASTOIDITIS

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A vast literature deals with climate in general terms. In the past, physicians have thought in terms of long-continued effects on the human organism and therefore of climate rather than weather. One of the real difficulties with the meteoropathologic literature is the fact that it almost invariably deals in general terms. More recently, the climatic factor as expressed in the weather and the season has begun to receive considerable attention. Huntington [1] in particular has studied the role of the American climate in a whole series of human reactions. Dexter [2] has described the associations of weather and behavior and Mills [3] the importance of the storm track for a variety of diseases. Petersen [4] has dealt exhaustively with the day by day influence of weather on the normal person and on the patient.

Since the weather and the season function together as perhaps the most important environmental factor from the time a human being is conceived to the time he dies, the fact that they can be measured with considerable accuracy affords a distinct advantage. Any number of environmental factors, such as emotion, diet, infection, intoxication and fatigue, influence a person, but it is extremely difficult to evaluate them. Definite alterations, however, such as those involved in daily changes of temperature, are measurable, although there is not always an absolutely uniform effect from meteorologic changes, because individual members of a community may protect themselves to different degrees.

There must be some reason why the acute infections reach a peak in the spring and not in the summer, why in certain years pandemics of influenza sweep the world, the disease being negligible at other times, and why certain persons remain resistant and others acquire an infec-

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1. Huntington, E.: Civilization and Climate, ed. 3, New Haven, Conn., Yale University Press, 1924.

2. Dexter, E. G.: Conduct and the Weather: An Inductive Study of the Mental Effects of Definite Meteorological Conditions, New York, The Macmillan Company, 1899.

3. Mills, C. A.: Climate as a Potential Factor in the Etiology of Exophthalmic Goiter and the Other Metabolic Diseases, Endocrinology **16**:52, 1932.

4. Petersen, W. F.: The Patient and the Weather, Ann Arbor, Mich., Edwards Brothers, Inc., 1934-1938, vols. 1-5.

tion. That bacteria penetrate the mucous membranes at certain times and that there are definite periods of greater or lesser susceptibility is known. Nedzel [5] has demonstrated such penetration of bacteria culturally as well as histologically.

Recent investigations by Sargent [6] concerning the common cold in normal young men observed under normal conditions of activity and subject to the same meteorologic conditions make evident that when a person is observed from day to day the initiation of a "cold" or a "sore throat" is always seen to be preceded by an episode involving a fall in temperature. The first stage of infection from the mucous membranes includes not only the presence of a suitable virus but the coincident biologic phase that makes penetration possible.

To avoid confusion it should be kept in mind that the human organism must adjust itself periodically to two wholly different types of atmosphere. A sudden fall in atmospheric temperature, usually associated with the passage of a polar air mass (cold front, or polar front), brings with it not only a change in temperature but lessened humidity and increase in barometric pressure. On the other hand, increasing temperature is characterized not only by a warmer air mass (warm front, or tropical front) but by greater moisture content and lower barometric pressure.

The precipitation of disease occurs in the wake of a cold front, when the functional status of the mucous membranes of the nose and throat has changed. A few hours to one or more days may elapse before the clinical symptoms make their presence felt. It is this latent, or incubation, period that not infrequently complicates the picture, because the actual initiation of the disease must follow the cold front closely.

One cold front may be passed clinically without harm. It is the superimposed cold front, striking the human organism before recovery has been possible, that results in further damage. A second insult may contribute to further biologic inadequacy. It is the infall of cold air that is pathogenic, either directly because of the meteorologically induced vascular spasm or indirectly because of changes that follow the vascular spasm.

In the presence of a polar front the effect of cold is only one of the factors that precipitates change. Atmospheric pressure, humidity and electrical potential and ionization, to mention only a few, differ, and the organism responds to an environmental change that is complex, just as its own response is complex. If the volume of the brain can

5. Nedzel, A. J., and Arnold, L.: Influence of Eggwhite upon the Absorption of Bacteria from the Intestinal Tract, Proc. Soc. Exper. Biol. & Med. **28**:358, 1931.

6. Sargent, F.: Studies in the Meteorology of Upper Respiratory Infections, Bull. Am. Meteorol. Soc. **19**:385, 1938.

be changed by alterations in atmospheric pressure, as Schildbrand [7] has demonstrated, the circulation of the brain will be changed, and if the circulation of the brain is changed one may anticipate alterations in the medullary centers, in the respiratory rate and in the pressor levels. Physiologists are just beginning to suspect the existence of such effects.

The vasomotor and biochemical changes induced in the population when a mass of polar air passes over have been described in detail by Petersen. At first the capillaries are less permeable, the blood pressure is increased, the tissues are less hydrated, and the blood is relatively more alkaline (carbon dioxide content decreased, p_H increased). In general, this might be termed a period of sympathicotonia which finds its reflection particularly in the peripheral tissues, including the mucous membranes of the nose and throat. Gradually the vascular spasm is dissipated, the vessels become dilated to accommodate the increased demand of the organism for greater oxygen consumption, the blood pressure falls, the membranes become more permeable and the tissues become relatively more acid and hydrated. At this time the opportunity for bacterial penetration presumably is greater. In this connection the work of Burrows [8] has been particularly significant.

Later, the bacteria having penetrated into the mucous membranes, disease is begun by local reactivity of the tissues, dissemination from the zone of penetration or localization in the body after dissemination. Localization in the tissues will be favored immediately by the alteration induced by vascular spasm.

Thus, the shift from one type of atmospheric mixture in which the group is existing to one diametrically opposite in most of its qualities is definitely associated with a shift in the physiologic phase, and under normal conditions the population is constantly swinging from a phase in which vascular spasm is enhanced to one in which vascular dilatation is augmented and vice versa, the condition being one of continuous flux in practically every physiologic and biochemical balance. As such fluctuations form a constant biologic phenomenon with the meteorologic accentuation existing in the northern hemisphere, definite alterations in resistance, susceptibility and bacterial invasion become evident. These environmental forces influence the speed, the direction, the amplitude and the phase interval of the metabolic processes and often produce the coup that pushes the organic mechanism over the edge of normality.

CLINICAL OBSERVATIONS

During 1938, 92 mastoidectomies were performed on children by the attending otologic staff of a pediatric hospital. I have selected 5 cases from the group to illustrate the influence of day by day meteoro-

7. Schildbrand, cited by Petersen,[4] vol. 2, p. 4.

8. Burrows, H.: Some Factors in the Localisation of Disease in the Body, London, Baillière, Tindall & Cox, 1932.

logic and seasonal changes on the clinical course of mastoiditis. Simplified meteorographs have been prepared from the United States government meteorologic data supplied by the local weather bureau. A comprehensive meteorograph would include daily temperature, barometric pressure, average wind velocity, sunshine scale and precipitation. For purposes of simplification, however, the high and low range of daily temperature may be regarded as an adequate index of meteorologic change.

REPORT OF CASES

CASE 1.—A white boy 5 years old had a "cold" about Oct. 13, 1938 (*A*, chart 1). Four days afterward there was pain in the right ear (*B*, chart 1), with suppuration

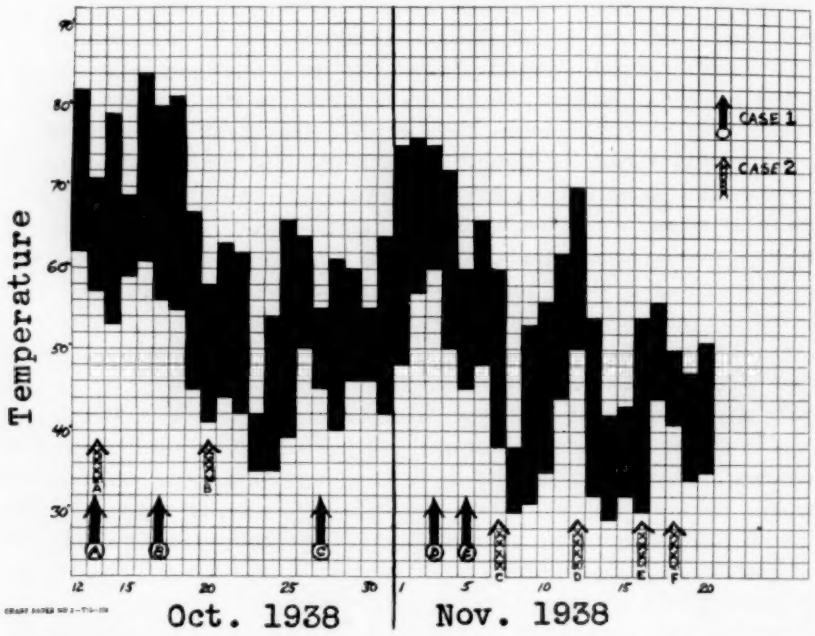

Chart 1.—Atmospheric temperature as involved in the clinical episodes of cases 1 and 2.

two days later. On October 27 the right postauricular area was noticeably swollen and tender (*C*, chart 1). A diagnosis of "surgical mastoid" was made on November 3 (*D*, chart 1), when the child was admitted to the hospital. Operation was performed on November 5 (*E*, chart 1). At this time the sinus plate was found to be necrotic and the sinus was exposed.

The association of meteorologic events and clinical episodes is clear. A "cold" began on October 13, with a mass of cold air passing over the city. The next polar front, on October 17, was associated with pain in the right ear and, as the mass of polar air continued, suppuration in the middle ear. Another polar front induced postauricular swelling and tenderness on October 27. Each succeeding polar front acted as a stinging blow and finally operation became necessary (November 5).

CASE 2.—On the same day (Oct. 13, 1938) on which the child in case 1 "took cold," another patient, a 10 year old girl, had an acute "head cold" (*A*, chart 1). She was kept in bed for two days. She felt better for a few days and then had pain in the right ear; the drum ruptured spontaneously, and suppuration commenced on October 20 (*B*, chart 1). The right ear drained profusely. On November 7 (*C*, chart 1) the left middle ear began to suppurate. For the next five days the drainage was profuse; cervical adenopathy became evident, and the mastoid was tender. On November 2 (*D*, chart 1) the patient was admitted to the hospital. On November 6 (*E*, chart 1) the preoperative temperature reached its peak at 103.2 F. Bilateral mastoidectomy was performed on November 18 (*F*, chart 1).

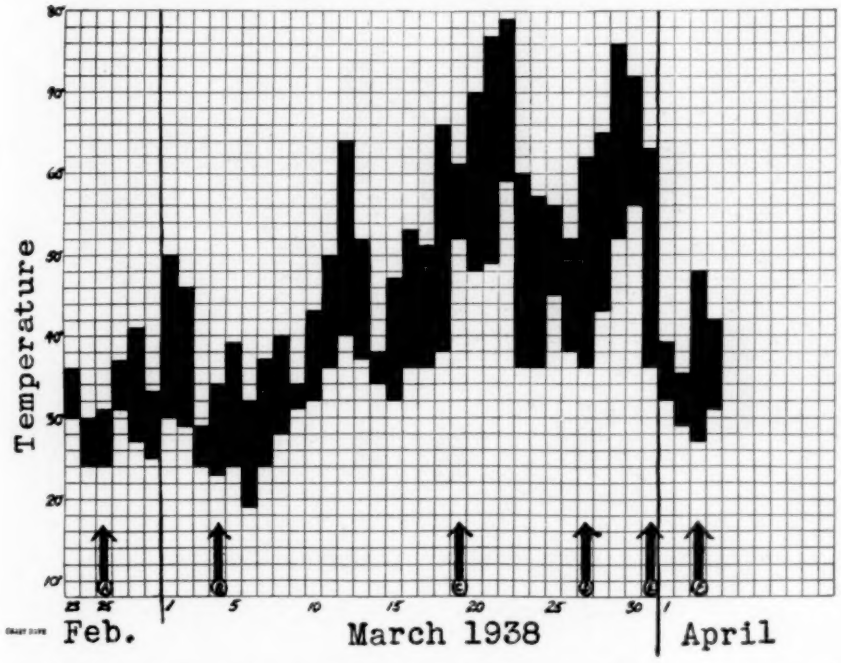

Chart 2.—Atmospheric temperature as involved in the clinical episodes of case 3.

As in the preceding case, the "head cold" began coincidentally with a cold front on October 13. The patient was better for a few days, but when a second polar front occurred the right ear began to suppurate. There followed a series of incidents associated with successive polar fronts. When another polar front appeared on November 7, the left ear began to suppurate. The patient was hospitalized on November 12. With the advent of the next serious cold front the preoperative temperature attained its highest level on the second coldest day (November 16) of the five week illness.

CASE 3.—A 10 year old girl began to complain of pain in the left ear on Feb. 25, 1938 (*A*, chart 2). Shortly afterward the left ear began to suppurate. On March 4 the right ear commenced to discharge (*B*, chart 2), draining intermittently

until March 19, when the child complained of severe pain; the mother reported that at this time the patient vomited and had fever (*C*, chart 2). The child was lethargic for one week, during which the ear again suppurated and the acute symptoms subsided. On March 27 a similar symptomatic episode (*D*, chart 2) occurred; there was pain, fever and vomiting. As soon as the ear suppurated the acute symptoms subsided. On March 31 the mother observed a swelling behind the left ear (*E*, chart 2). The child was brought to the hospital, where a diagnosis of mastoiditis on the left with zygomatic involvement was made. A mastoidectomy (*F*, chart 2) was performed on April 2.

From the meteorograph it will be noted that an earache on the left with subsequent suppuration followed a clinical episode associated with a polar front. A

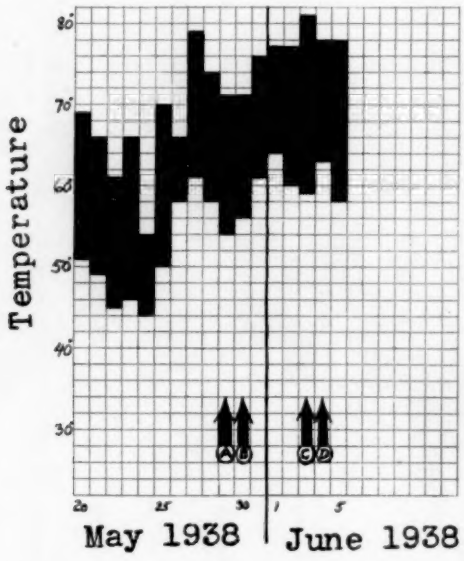

Chart 3.—Atmospheric temperature as involved in the clinical episodes of case 4.

subsequent polar front was associated with suppuration in the right ear (March 4). There was a period of relative symptomatic quiescence with the advent of a warm front, but on March 19, after another cold front, the child had pain and fever and vomited. One week later, on March 27, the acute symptoms reestablished themselves after a marked polar front. On March 3 another severe cold front induced the major effect of autonomic disturbance, and the child had surgical mastoiditis.

Case 4.—The mother of a 6 month old boy reported that the baby had earache on the right side on May 29, 1938 (*A*, chart 3). There was no history of a "cold." The following day a swelling (*B*, chart 3) in the right postauricular region was observed. On this day (May 30) a paracentesis was done. Irritability and fever continued. On June 3 the child was hospitalized, with a diagnosis of mastoiditis on the right with subperiosteal abscess (*C*, chart 3). A mastoidectomy (*D*, chart 3) was performed on June 4.

The meteorologic data indicate that the onset of the earache and the subsequent postauricular swelling occurred coincidentally with a polar front on May 29 and 30. This episode followed a severe cold front several days before. A second polar front, on June 3, was sufficient to "balloon" the clinical symptoms into full blown mastoiditis.

CASE 5.—A 5 year old boy had a "cold" (*A*, chart 4) on Dec. 22, 1937. Two days later a paracentesis of the right ear drum (*B*, chart 4) was done on a bulging, highly inflamed drum membrane. On December 28 the boy had pain in the left ear (*C*, chart 4). Three days later, on December 31, he was admitted to the hospital (*D*, chart 4). At this time a paracentesis of the left ear drum was done. On January 1 (*A*, chart 4) and 2 (*F*, chart 4) the temperature fluctuated

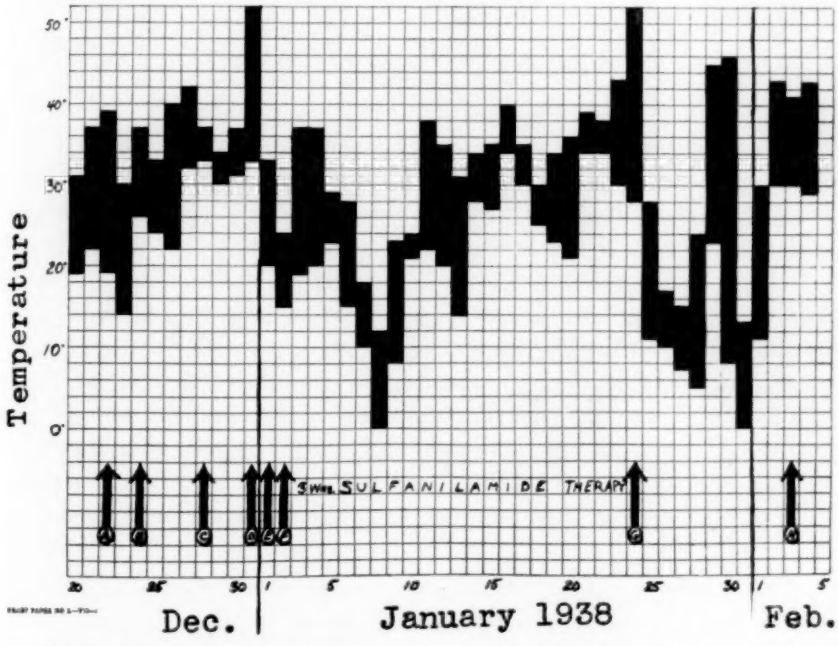

Chart 4.—Atmospheric temperature as involved in the clinical episodes of case 5.

between 102.8 and 101.6 F. The patient was toxic. Sulfanilamide therapy was given for three weeks, but the mastoiditis did not respond sufficiently to avoid the necessity of a mastoidectomy (*G*, chart 4), which was done on Jan. 24, 1938. The patient was discharged from the hospital (*H*, chart 4) on February 3.

In this case the role of the meteorologic events seems relatively simple and clearcut. A "cold" and paracentesis of the right ear drum occurred in association with an initial polar front. A second polar front was associated with pain in the opposite ear. At the onset of a third polar front a paracentesis was required for the left ear. At this time the patient was hospitalized. On January 1 and 2 the temperature mounted. The child was given sulfanilamide therapy. It will be noted that the sulfanilamide was inadequate during a series of severe polar fronts (January 7 was the coldest day of the winter). Finally, the child was operated on (January 24).

CONCLUSION

The climatic factor in mastoiditis, as expressed in terms of the weather and the season, can be measured with considerable accuracy.

The precipitation of this disease most often occurs in the wake of a fall in atmospheric temperature (cold front or polar front), when the functional status of the mucous membranes of the nose and throat has changed.

Five cases of mastoiditis in children are described to illustrate the influence of day by day weather and seasonal changes on the clinical course of mastoiditis.

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EXPERIENCES WITH SULFANILAMIDE THERAPY FOR OTOGENOUS INFECTIONS

WITH SPECIAL REFERENCE TO MASKING OF THE CLINICAL COURSE

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NEW YORK

With the advent of sulfanilamide, a new form of chemotherapy has resulted in a tremendous advance in the treatment of certain types of otitic infection. The literature is now replete with many theoretic, experimental and practical considerations of the value of this remarkable drug. The outstanding result of its use for otogenous infections is the astounding improvement of the prognosis in conditions, such as meningitis, which hitherto were regarded as utterly hopeless. In the literature before the use of sulfanilamide, recovery in cases of streptococcic meningitis was reported, but it was comparatively rare. In July 1935 Gray [1] presented a summary of the literature on this subject. He found 66 cases of recovery, including his own, reported in the last thirty-five years. He felt that streptococcic meningitis was fatal in at least 97 per cent of cases.

In the experience of most otologists the outstanding fact during the greater part of the past twenty-five years was the futility of any measures in behalf of sufferers from this hopeless condition. During the first fifteen years of the period, it was customary to have the patients admitted to the medical or the neurologic service, and, as the prognosis was regarded as hopeless, only palliative measures were used—morphine, in large doses, being the drug usually administered. Any operation performed was in the nature of an antemortem procedure.

During the second period, i. e., the ten years preceding the advent of sulfanilamide, knowledge of the pathways of infection to the meninges was considerably increased by histologic studies of petrositis. As this

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1. Gray, H. J.: Streptococcic Meningitis: Report of a Case with Recovery, J. A. M. A. **105**:92 (July 13) 1935.

otitic complication is responsible for the largest number of cases of meningitis, the studies soon led to a keen interest in the various clinical aspects of petrositis and their diagnosis, and the surgical indications for intervention. Attention was directed also to other avenues of invasion of the meninges: The involvement may occur, for instance, by way of the middle ear, through dehiscences in the roof or a destructive process in the region, through the mastoid proper, or by way of the labyrinth; it may follow sinus thrombosis, either by direct extension or by embolic deposits in the meninges occurring during a general invasion.

As a result of these studies more thorough surgical eradication of the otitic focus was done; new operative procedures for drainage of the petrosal lesions were devised, and various measures were employed to combat the meningeal infection, such as chemotherapy with Pregl's solution (iodine) or mercurochrome, intracarotid injection of various dyes, repeated blood transfusions, specific serums, Kubie's forced spinal drainage or repeated lumbar taps.

During this period, despite these operative and nonoperative procedures, only an occasional recovery was recorded. The mortality still was placed at over 97 per cent. While recoveries were few, it was not infrequently observed that the measures employed resulted in prolongation of the illness.

We now come to the present treatment—in use for less than two years. The results from the use of sulfanilamide reported from all over the country and abroad have been amazing It must be remembered that a majority of recoveries from otitic meningitis occurred in instances in which the focus in the temporal bone had been thoroughly eradicated in conjunction with the proper administration of sulfanilamide. In other words, this form of therapy seems to be ineffective if the original focus is not removed. While sulfanilamide will clear body fluids infected by streptococci, its action is apparently less effective on streptococci in an active osseous lesion. We have demonstrated to our satisfaction that unless proper surgical measures are employed the only effect of sulfanilamide is partial control of the disease and a tendency to prolong its course.

A form of medication so recent must necessarily give rise to a divergence in opinion regarding indications, methods of administration, dosage and prophylactic use.

We have been opposed to the indiscriminate administration of sulfanilamide for infections of the upper part of the respiratory tract, many of which run a self-limited course in any event. The free use of this preparation, aside from the dangers of toxicity, frequently obscures the clinical picture and often gives rise to a latent course of the disease.

Latent forms of mastoiditis and its complications are known to occur. Our point of view regarding the administration of sulfanilamide for minor infections of the upper part of the respiratory tract is necessarily subject to change; however, for the present we use the drug only in otitic complications, such as meningitis, sinus thrombosis and abscess of the brain. Prophylactically we use it also in the so-called protective or sympathetic forms of meningitis associated with mastoiditis and its complications. Because of its tendency to obscure the clinical course of the infection, our point of view at present is that sulfanilamide should be used cautiously if at all in acute otitis media. It is contraindicated during the course of suspected mastoiditis before operation and also after operation unless a diagnosis of one of the complications mentioned has been made.

To be more specific, we feel that for the present, at least, the indications for this form of chemotherapy from our experience are as follows:

Sufanilamide may be given in otitis media before suppuration has taken place. We have not had sufficient experience in its use in this stage but pediatrists report favorable results. We know, however, that otitis media of this type commonly proceeds to spontaneous resolution.

Occasionally, in cases of extreme bacterial meningitis (streptococcic or pneumococcic), intensive administration is indicated before operation (twenty-four to thirty-six hours) and then postoperatively.

In sympathetic meningitis secondary to an extradural abscess, an abscess of the brain or labyrinthitis, sulfanilamide should be given. Removal of the otitic focus is imperative.

In thrombosis of the lateral sinus, as soon as the diagnosis has been established, administration of sulfanilamide should be instituted, followed by thorough operative intervention. It should be continued during the postoperative period. The drug is especially useful in instances of continued otitic sepsis, even though a thorough operative procedure has been previously performed. In such conditions phlebitis of various venous radicles tributary to the lateral sinus and inaccessible to surgical intervention may be responsible for the continuation of the sepsis.

In petrositis sulfanilamide should not be administered during the period of observation because of the danger of masking the clinical course and thus interfering with the proper management of the condition. Should operation be indicated, it is advisable to give sulfanilamide promptly in the usual manner.

That the indiscriminate use of sulfanilamide may result in latent forms of infection of the middle ear or the mastoid and their complications has been mentioned but scantily in the literature. The important

fact that sulfanilamide tends to mask the clinical picture of otitic infection has been observed sufficiently often to warrant drawing attention to it. A striking example of latency due to the administration of sulfanilamide was recently reported by Smith and Coon,[2] who stated that it is possible that a moderate dose of sulfanilamide will partially control meningitis so that it will present an unfamiliar clinical picture. During the course of acute suppuration of the middle ear their patient, a 6 year old child, had been receiving moderate doses of sulfanilamide. Following a mastoidectomy a clinical picture of sepsis presented itself; i. e., the patient had a spiking temperature between 100 and 104 F., for which no other cause could be assigned, despite negative blood culture. A Tobey-Ayer test was done to confirm a strong suspicion of the presence of thrombosis of the lateral sinus, but to the astonishment of those present the spinal fluid was cloudy, showed a high cell count and on culture yielded Streptococcus haemolyticus. The patient had been euphoric and symptom free throughout. The mastoidectomy was revised, and intensive sulfanilamide therapy was then given, followed by recovery.

Relative to the masking of the clinical course resulting from the administration of sulfanilamide is the following note, appended to an interesting article by Ballenger, Elder, McDonald and Coleman:[3]

NOTE—Since this paper was read, confirmation of our conclusions has been offered by J. S. Lockwood (Observations on the Mode of Action of Sulfanilamide and Its Application to Surgical Infections, *Ann. Surg.* **108**:801-812 [Nov.] 1938). Lockwood showed that even a small amount of peptone or of peptone-like products greatly retards the germicidal activity of sulfanilamide. As far back as 1911 Bainbridge had shown that some species of bacteria are unable to break down the protein molecule to obtain essential nitrogen. In consequence they starve to death in serum protein or egg albumin unless predigested protein in the form of peptone is supplied. Lockwood asserted that pus and tissue undergoing necrosis contain peptone-like products which prevent sulfanilamide from acting on the micro-organisms with the maximal effect that characterizes its effect on diffuse nonsuppurative infections. In a later paper (Studies on the Mechanism of the Action of Sulfanilamide, *J. A. M. A.* **111**:2259 [Dec. 17] 1938) Lockwood and his associates stated that relapses "were frequent in patients with localized infections containing necrotic tissue, such as mastoiditis and abscesses, whereas in bacteremia and erysipelas they were not encountered." They asserted that "the presence of débris, human or bacterial, diminished the effectiveness of sulfanilamide on the hemolytic streptococcus."

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2. Smith, H. B., and Coon, E. H.: Meningitis Due to a Hemolytic Streptococcus: Report of Two Cases with Recovery After Use of Prontosil and Sulfanilamide, Arch. Otolaryng. **26**:56 (July) 1937.

3. Ballenger, E. G.; Elder, O. F.; McDonald, H. P., and Coleman, R. C.: Failures in the Treatment of Urinary Tract Infections with Sulfanilamide, J. A. M. A. **112**:1569 (April 22) 1939.

Otologists for a long time have been familiar with the clinical course of otitic infection due to Pneumococcus type III. The characteristic insidious clinical picture which an infection with this organism produces is almost identical with that resulting in some cases from the use of sulfanilamide during acute otitis media. There is the same freedom from pain; tenderness over the mastoid, which may be present at first, soon lessens or disappears; there may be apparent improvement of the infection in the middle ear, indicated by diminution or absence of discharge, but on further examination one notes the appearance of an unresolved infection, i. e., a thickened drum with absence of landmarks. Resolution may be much delayed, or a recurrence of signs of infection of the middle ear, with evidence of involvement of the mastoid or an otitic complication, may rather abruptly follow a longer or shorter period of latency. Otitic complications run an asymptomatic or atypical course, as pointed out in a number of cases which we have reported.

We suggest to those who are of the opinion that sulfanilamide should be given from the very beginning of otitis media that the patients be carefully observed over an extended period, despite apparent improvement in the otic picture and absence of symptoms; furthermore, as a therapeutic test, we advise the discontinuance of the drug for a few days during the period of observation to note whether a recrudescence of signs or symptoms of postauricular infection occurs. We have made the latter observation in a number of instances in which the drug had been given for a considerable time.

The reports of cases 1 to 6 and case 15, with the comments, illustrate the various phases of the masking effect of sulfanilamide observed in some cases of otogenous infection.

The administration of sulfanilamide has varied greatly from the time of its early use to the present. As the newer knowledge of its action, toxicity and therapeutic effect has come to light, modifications of the usual clinical pictures have been observed. Early in its use small doses were administered at irregular intervals and then withdrawn with the onset of cyanosis. With the knowledge that oxygen capacity, carrying power and saturation were but little affected, larger doses were given. Bigler, Clifton and Werner [4] administered the drug by mouth on the basis of 15 grains (1 Gm.) to 20 pounds (9 Kg.) of body weight irrespective of age, sex or color. Long and Bliss [5] gave an initial dose of fourteen to sixteen 5 grain (0.32 Gm.) tablets of sulfanilamide with the intention of obtaining a concentration in the blood

4. Bigler, J. A.; Clifton, W. M., and Werner, M.: The Leukocyte Response to Sulfanilamide Therapy, J. A. M. A. **110**:343 (Jan. 29) 1938.

5. Long, P. H., and Bliss, E. A.: Para-Aminobenzenesulfonamide and Its Derivatives: Clinical Observations on Their Use in the Treatment of Infections Due to Beta Hemolytic Streptococci, Arch. Surg. **34**:351 (Feb.) 1937.

of 10 mg. per hundred cubic centimeters within four hours in patients weighing 100 pounds (45 Kg.). To maintain this level three 5 grain (0.32 Gm.) tablets were administered every four hours. For patients weighing 50 to 90 pounds (23 to 41 Kg.) an initial dose of six to ten 5 grain (0.32 Gm.) tablets was given, followed by a maintenance dose of two to three 5 grain (0.32 Gm.) tablets every four hours. The same authors suggested for hypodermoclysis in adults, an initial dose of 500 cc. of an 0.8 per cent to 1 per cent solution, followed by 300 cc. of the same solution at eight hour intervals.

The method of administration that we have adopted is similar to that of Long and Bliss. Since the drug is apparently completely absorbed from the gastrointestinal tract in four hours, the four hour maintenance dose was selected. It is our aim for all severely toxic patients to attain a concentration in the blood of 10 to 15 mg. per hundred cubic centimeters as rapidly as possible. In an effort to do this, all available routes of administration are attempted, according to the patient's ability to take the drug by mouth. When this is impossible, hypodermoclysis and intravenous and intramuscular routes are employed. Intrathecal administration was soon discontinued because of the marked cytologic change caused by the drug, with elevation of temperature. Also it was noted by Marshall [6] that the concentration in the cerebrospinal fluid is close to the concentration in the blood and intrathecal administration is of no advantage. Since forty-eight hours was required for the beginning of a therapeutic effect, our greatest dose is given early, with a maintenance dose that depends on the concentration in the blood. Since, as has been shown, the latter varies directly with urinary output, an attempt to limit fluids during the first twenty-four hours tends to earlier attainment of a higher concentration.

Because of the rapid loss by excretion of the drug, it is our policy to continue its administration day and night at regular three or four hour intervals, thus assuring maintenance of the level in the blood.

It is our experience that not all patients of the same weight respond similarly to identical dosage. We therefore vary our dosage with different patients according to the concentration attained in the blood.

Our dosages are modified considerably by the severity and toxicity of the patient's condition. Ottenberg [7] stated that in overwhelming infections one should disregard the possible toxic systemic effects of the drug in an attempt to overcome the infection as early as possible. As will be pointed out, the progressive fall in hemoglobin witnessed during the administration is controlled by small repeated transfusions.

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6. Marshall, E. K., Jr.: The Determination of Sulfanilamide in the Blood and the Urine, Proc. Soc. Exper. Biol. & Med. **36**:422 (April) 1937.

7. Ottenberg, R.: Treatment of Hemolytic Streptococcus Infections and Newer Applications of Sulphanilamide, Bull. New York Acad. Med. **14**:453 (Aug.) 1938.

Marshall [6] showed that sulfanilamide is almost equally distributed in all tissues of the body, excluding fat and bone. It is the latter finding that makes it imperative for sulfanilamide to be used only after the suppurative focus in the bone has been eradicated.

When severe infections appear to be overcome, it is a natural tendency to reduce the intake of a potentially toxic drug like sulfanilamide. In a number of our cases premature discontinuance of the drug was followed shortly by exacerbation of the symptoms previously mentioned. Administration of the drug was again influential in clearing the infection. Gradual reduction of the intake is advisable and should depend on the clinical course and the progress of the patient unless, of course, signs of acute intoxication supervene.

It has been our experience with the use of proprietary preparations like neoprontosil that the exact calibration of the drug is more difficult than with sulfanilamide itself. The complicating factor of the azo dye confuses the known indexes for its use. Since it is probable that the aforementioned drug acts by a reduction to sulfanilamide and that in the prontosil molecule sulfanilamide is the effective radical for treatment of infections, sulfanilamide is the drug of choice.

When the clinical indications existed, we have supplemented sulfanilamide therapy with small repeated blood transfusions to combat the hemolytic effect of the drug. Occasionally, specific antiserums have been used, but they were given empirically in streptococcic infections and without controls.

Basman and Perley [8] suggested supportive treatment with isotonic sodium lactate or lactate-Ringer solution and dextrose to combat acidosis and dehydration.

Daily, and sometimes more frequent, lumbar punctures are done both for relief of intracranial hypertension and for drainage. There is apparently no more advantage in continued drainage than in frequent lumbar taps.

During the past few months numerous encouraging reports have appeared in the British medical journals, especially the *Lancet,* on the treatment of severe, fulminating pneumococcic meningitis of otitic and other origin. The drug used, sulfapyridine, is variously referred to (for instance, as M & B 693 and dagenan) and is essentially sulfanilamide with a pyridine substitution factor. It is said to be more effective than the original preparation, sulfanilamide, against both streptococcic and pneumococcic infections. As yet, our experience with the drug does not warrant commitment, but the reports of its use are highly favorable. The toxicity of the drug is said by various observers to be less than that of sulfanilamide.

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8. Basman, J., and Perley, A. M.: Report of Patients Treated with Sulfanilamide at St. Louis Children's Hospital, J. Pediat. **11**:212 (Aug.) 1937.

REPORT OF CASES

The following cases are reported with comments to illustrate many of the points discussed:

CASE 1.—D. Y. gave a history of pain in the left ear, followed one week later by myringotomy with Str. haemolyticus obtained from the ear. A thin pulsating discharge continued for the next three weeks. Hearing was impaired; the nasal sinuses were clear. The patient was given 10 grains (0.6 Gm.) of sulfanilamide every four hours. Twenty-two days after the onset of infection, nystagmus to the right and left developed, more marked to the left. This continued unabated, associated with supraorbital headache. The middle ear showed evidence of resolution up to the day before operation, when the ear drum became full and the middle ear began to discharge. On pressure over the mastoid, the patient complained of slight soreness but no actual pain. The administration of sulfanilamide was stopped.

Mastoidectomy was performed on the left, and marked destruction of the mastoid was observed; the dura was covered with fine granulations. The possibility of petrositis was considered because of the nocturnal pain, slight postauricular tenderness, thick discharge, subfebrile course and nystagmus directed to the diseased ear. The patient is now apparently on her way to recovery.

Comment.—The clinical picture was masked by sulfanilamide, which produced a low temperature, absence of pain and evidence of resolution of the infection in the middle ear without signs of involvement of the mastoid. Petrositis was the first indication of an otitic complication, without apparent postauricular disease.

A great deal more pathologic change in the mastoid was found than was clinically suspected.

In the early stages, postauricular tenderness was marked. Following the administration of sulfanilamide, the tenderness was definitely absent, although there were evidences of petrositis.

CASE 2.—In T. A., a 10 year old girl who had scarlet fever, acute otitis media developed, for which myringotomy was performed. The ear drained continuously and profusely. The area over the mastoid was not tender. The patient had been given sufanilamide for thirty days, about 20 to 30 grains (1.3 to 1.9 Gm.) per day, with no cessation of the aural discharge. For one month there was no headache or postauricular pain.

When first seen, the child had a temperature of 99.5 F. and was comfortable. Vague temporal headache had occurred one day before. There were slight postauricular tenderness and a profuse discharge. The administration of sulfanilamide was stopped, and the next day the temperature rose to 102 F. The child became restless, and headache became marked. Postauricular tenderness was definitely increased.

Simple mastoidectomy revealed extensive disease everywhere in the mastoid, with complete destruction of the zygoma and the tip. Culture of material removed at operation revealed Str. haemolyticus beta.

Comment.—Sulfanilamide was given early in acute otitis media.

Definite progression to coalescent mastoiditis occurred despite the drug.

Headache, fever and other clinical evidence were absent, despite marked destruction of the mastoid.

Twenty-four hours after the discontinuance of sulfanilamide, fever, headache and postauricular tenderness appeared, when the masking effect of the drug was removed.

The ineffectuality of the drug in the presence of a suppurative focus and its capacity to attenuate the course of disease without preventing its progression were demonstrated.

CASE 3.—I. C., a 5 year old white boy, had pain in the left ear two days before admission to the hospital, following cough and fever for ten days. Examination revealed an acutely ill child. The right ear drum was normal; the left was full, red and covered with hemorrhagic blebs and a thin pulsating discharge. Signs of bronchopneumonia were present. The child was given sulfanilamide with the onset of otitis.

Two days after admission, the temperature rose to 105 F.; the child became irritable, and there were meager clinical signs suggestive of meningeal irritation. Lumbar puncture showed an increase of pressure, with cloudy fluid containing 230 cells per cubic centimeter, with 92 per cent polymorphonuclear cells. Subsequently the fluid was reported to contain Str. haemolyticus beta, as did the culture of material from the middle ear. A blood culture was sterile.

The child was given sulfanilamide at four hour intervals day and night; 120 grains (7.8 Gm.) were given the first twenty-four hours and the dose then reduced to 90 grains (5.8 Gm.) per day. The concentration in the blood was kept at 8 to 10 mg. per hundred cubic centimeters. The fever precipitously subsided, and the child was comfortable during the next ten days, despite the persistence of meningitis, indicated only by examination of the spinal fluid. Within forty-eight hours after the administration of larger doses of sulfanilamide (90 grains [5.8 Gm.] daily), all clinical evidence of meningitis disappeared except for the findings in the spinal fluid. The high cell count continued for a few days, and the polymorphonuclears, which had increased, were soon replaced by lymphocytes, until, on the day before the mastoidectomy, the spinal fluid showed a count of 12 lymphocytes. Culture of the spinal fluid revealed Str. haemolyticus on only one occasion. A few days later, however, slight but increasing postauricular tenderness was noted, with persistence of moderate aural discharge.

Twelve days after admission and ten days after the onset of meningitis, simple mastoidectomy was performed. Complete destruction of the mastoid without involvement of the dura or lateral sinus was found.

Comment.—Meningitis occurring two days after the onset of acute otitis media was clinically controlled by massive doses of sulfanilamide; the child remained comfortable and playful, with a temperature of 100 to 100.5 F., despite meningitic activity, indicated only by lumbar puncture.

Our clinical concept of mastoiditis was definitely altered by sulfanilamide.

CASE 4.—R. R., aged 25, had had acute infection of the upper part of the respiratory tract six days before her admission to the hospital. On the morning of admission she complained of severe pain in the left ear and supraorbital headache on the left.

Examination revealed acute otitis media, with all landmarks missing. The hearing was impaired. Myringotomy was performed with the patient under general anesthesia; thick pus was obtained under pressure, which subsequently yielded a culture of Str. haemolyticus. After myringotomy, the ear continued to discharge a thick purulent secretion, and tenderness over the left mastoid developed on the fourth day. The patient was then given sulfanilamide, 90 grains (5.8 Gm.), each day for six days. During this period the discharge diminished greatly; the drum remained full, and tenderness over the mastoid was still present but was diminished. On the fifteenth day of the otitic history, the patient complained of pain behind the left eye. There were a few nystagmoid jerks when she looked to the right; the hearing was impaired to perception of a loud whisper; the patient complained of a loud, annoying thumping in her ear. The fundus of the ear revealed a full, pulsating drum, without discharge, visible landmarks, or changes in the walls of the canals. There was slight tenderness over the mastoid and the emissary vein. Administration of sulfanilamide was stopped.

The patient remained in the hospital for three and one-half weeks. There was a picture of delayed resolution of the infection in the middle ear. Just before her discharge from the hospital, i. e., on the twenty-third day of the otitic history, the drum still remained full, and only a short process was visible.

The patient was observed closely after her discharge from the hospital, up to the sixth week of the otitis, when there was evidence of the beginning of resolution of the infection in the middle ear.

Comment.—This is a case of acute otitis media in which sulfanilamide had been given. The subsequent clinical picture became exceedingly bizarre; symptoms were masked, and the infection in the middle ear remained unresolved for six weeks. For a considerable period it was difficult to state whether we were dealing with a latent mastoiditis or an unusual form of otitis media.

Case 5.—C. L., a 63 year old woman with diabetes, was admitted to the hospital with a ten day history of discharge from the ear following infection of the upper part of the respiratory tract. Culture of material from the ear showed Pneumococcus type III. Simple mastoidectomy, performed three weeks after the onset, revealed multiple abscesses everywhere in the mastoid. The sinus was yellowish white, contained thick pus and was obliterated by an obturating thrombus. Further procedure was not carried out, because of the patient's condition. Postoperatively her diabetic condition was always under control. Sulfanilamide was given intravenously and by mouth. For three weeks after the operation, her condition was subfebrile, and then a sudden chill developed, with a rise of temperature to 104 F. At this time the internal jugular vein was ligated. The patient died two days afterward, having had preagonal alternating jacksonian tremors. Blood culture at this time showed Pneumococcus type III. Postmortem examination showed extension of an obturating thrombus to the torcular Herophili, into the superior longitudinal sinus and over to the opposite lateral sinus and jugular bulb.

Comment.—Thrombosis of the lateral sinus was due to Pneumococcus type III.

The postoperative course may have been altered by sulfanilamide.

This form of medication should not be given postoperatively unless the sinus has been thoroughly obliterated. There is a risk of masking

the true clinical picture while progressive extension of the thrombophlebitis takes place.

CASE 6.—J. L., a woman 22 years of age, had an infection of the upper part of the respiratory tract two weeks before her admission to the hospital. Four days before admission pain in the left ear developed, followed by myringotomy one day later. For two days before admission she had been dizzy; the type of vertigo was not carefully described. The temperature ranged between 100 and 102 F.; she did not have chills or convulsions, but she did have marked parietal headache.

Ten days after admission signs of acute mastoiditis developed, and simple mastoidectomy was done on the left, with the patient under general anesthesia. The mastoid was large, with no destruction of the intercellular septums. Each cell contained thin pus, from which Str. haemolyticus beta was subsequently cultured. After operation the patient had sustained febrile reaction, which could not be accounted for by a local aural condition. Fifteen days after operation she began to complain of pain over the left eye, and at this time the possibility of suppuration of the petrous pyramid was thought of. Examination of the nose and paranasal sinuses did not reveal anything at this time. Twenty days after the original mastoidectomy, the wound was revised, and the petrous pyramid was investigated. Granulations were removed from the plate of the sinus and that of the middle fossa. No tract was visible in or around the semicircular canal. The squama was removed and the dura of the middle fossa elevated from the superior surface of the petrous pyramid. This was done with ease, because a large amount of fluid was removed by spinal tap prior to operation. A large gush of nonodorous thick creamy pus was obtained from a pit about ½ inch (1.3 cm.) anterior to the arcuate eminence. A rubber drain was inserted and the wound closed. Culture of the pus showed Str. haemolyticus. The patient received repeated transfusions. Lumbar puncture, performed five days later because of headache and some rigidity of the neck, revealed evidence of meningitis, with fluid containing 4,500 cells, 80 per cent polymorphonuclears and 20 per cent lymphocytes, and yielding no organisms on smear. At this time, one month after the original mastoidectomy, the possibility of an abscess of the brain was considered, but no localizing signs were found. Repeated spinal taps were done. The patient was given large doses of sulfanilamide, the hemoglobin watched and the sulfanilamide content of the blood and spinal fluid determined at regular intervals.

About forty days after the original operation it was first noticed that anomia and a few vague changes in the deep and superficial reflexes had developed. Blood cultures were repeatedly negative. At this time an abscess of the brain, loculated meningitis and otitic hydrocephalus were all considered, but no definite diagnosis could be made. Because of the persistence of the findings in the spinal fluid, the wound was reinvestigated. The dura was seen to be covered by a thick yellow exudate, and on elevation of the dura of the middle fossa again a gush of thick creamy pus appeared. Loculated pockets were not found. Because of the persistence of fever and of the findings in the spinal fluid, repeated attacks of vomiting and transient anomia, eight days after the reexploration of the petrous pyramid an exploratory craniotomy for an abscess of the left temporal lobe of the brain was performed. Aspiration in several directions in the temporal lobe failed to show any pus. The dura was incised, and it was noted that the brain had a peculiar yellow discoloration, but no pus was found. After the craniotomy the patient's condition was about the same until dressing was done ten days later and the probe fell into a cavity in the temporal lobe. A few ounces of thick

pus escaped. After drainage of this abscess cavity, the patient's condition progressively improved; the neurologic symptoms gradually subsided, and except for the peculiar mental changes, the patient appeared to be getting well. Gradually thereafter, the spinal fluid became clear; the mental state returned to normal; the temperature became normal, and the patient progressed to an uneventful recovery with no sequelae other than some diminution of hearing.

Comment.—The patient had acute mastoiditis complicated by suppurative petrositis, streptococcocic meningitis and an abscess of the temporal lobe.

The clinical picture of otitic meningitis was masked by the use of sulfanilamide. On a number of occasions except for a moderate fever the patient was symptom free. Physical signs were absent, and yet spinal tap gave definite evidence of meningitis, i. e., an increase in cells and streptococci.

Until the otitic focus was adequately dealt with, sulfanilamide only partially controlled the meningitis.

The course (two and one-half months) of meningitis was prolonged under administration of sulfanilamide.

CASE 7.—B. R., a German emigree, came to America eight days prior to her admission to the hospital. She was perfectly well up to three days before admission, when pain in the right ear developed. Myringotomy was done on the day before admission, with discharge of pus.

The patient was acutely ill and complained of occipital and frontal headaches. Examination of the ear showed a seropurulent nonpulsating discharge on the right side. The hearing was poor. Evidence of mastoiditis was not present. The nose showed some mucopus and crusts on both sides. The mucosa was acutely inflamed. Smears from the sphenoid sinus at this time showed some pus cells and some gram-positive diplococci. The patient had moderate stiffness of the neck, a positive Kernig sign and absence of the abdominal reflexes. There was suggestive paralysis (lower) of the right facial nerve.

Spinal tap on admission showed the fluid with a ground glass appearance, under increased pressure. There were 1,800 cells per cubic centimeter, with 94 per cent polymorphonuclears. Organisms were not seen on smear. The blood count was 10,000 cells per cubic centimeter, with 84 per cent polymorphonuclears. A culture of the first spinal fluid was negative. The patient was given antimeningococcus serum intraspinally. Sulfanilamide therapy was begun immediately. Spinal tap done the next day showed 1,200 cells, with 90 per cent polymorphonuclears. Culture of the spinal fluid contained Str. haemolyticus beta.

Examination of the ear at this time showed a thick purulent pulsating discharge from the middle ear, with the peripheral paralysis of the facial nerve still moderately well marked. At this time, however, there was a large central perforation of the drum, which had not been seen, or was not present, before. It was difficult, therefore, to decide whether the patient had had chronic otitis with an old perforation or whether the picture was that of acute massive destruction of the drum. Another spinal tap, done four days after admission, showed the fluid to contain Str. haemolyticus beta. Because of the paralysis of the facial nerve and the picture in the middle ear, we were inclined to believe at this time that the mastoid was the seat of the primary focus. Operation, however, was not

performed. For three or four days, the patient was treated with neoprontosil [9] and sulfanilamide in massive doses. The cell count of the spinal fluid became progressively less, with diminution of the number of polymorphonuclears and an increase in the number of lymphocytes. The culture of the spinal fluid, which on three occasions had contained Str. haemolyticus beta, was now negative.

Eight days after admission, a marked urticarial eruption developed, probably due to the serum. Slowly but progressively the paralysis of the facial nerve became less marked; the spinal fluid became clearer throughout the patient's stay, and the results of examination of the nose and throat were considered entirely negative. The condition improved markedly; the discharge from the ear became scant; the perforation became smaller; finally, spinal tap showed a normal chemical and cytologic picture and no growth.

The patient was in the hospital for eight weeks before she was discharged as cured.

SULFANILAMIDE THERAPY

3/27 to 3/28	40 cc. of neoprontosil (given intramuscularly)
	300 cc. of 0.8 per cent solution of sulfanilamide (given subcutaneously)
3/28 to 3/29	80 cc. of neoprontosil (given intramuscularly)
3/29 to 3/30	60 cc. of neoprontosil (given intramuscularly)
	50 grains (3.2 Gm.) of sulfanilamide
3/30 to 3/31	50 grains (3.2 Gm.) of sulfanilamide
3/31 to 4/1	60 cc. of neoprontosil (given intramuscularly)
4/1 to 4/2	20 grains (1.3 Gm.) of sulfanilamide
4/2 to 4/3	50 grains (3.2 Gm.) of sulfanilamide
4/3	40 grains (2.6 Gm.) of sulfanilamide
4/4	40 grains (2.6 Gm.) of sulfanilamide
4/5	40 grains (2.6 Gm.) of sulfanilamide
4/6	20 grains (1.3 Gm.) of sulfanilamide
4/10	20 grains (1.3 Gm.) of sulfanilamide

Comment.—Otogenous streptococcic meningitis developed three days from the onset of otitis media.

The patient recovered, without operative intervention, with the use of sulfanilamide over a long period.

The importance of a knowledge of the pathway of invasion of the meninges is illustrated.

CASE 8.—P. K., a 13 year old girl, was admitted to the otologic service of the Mount Sinai Hospital with a history of infection of the upper part of the respiratory tract followed by pain in the right ear, for which myringotomy had been performed three weeks previously. On admission, the child was acutely ill, somnolent but responsive.

Findings of interest were essentially limited to the ears. The right ear showed a pulsating, purulent discharge, which reappeared after it was wiped away. The duration of the discharge, as stated was three weeks. There was slight but definite tenderness over the antrum of the mastoid, with no definite changes in the walls of the canals. There was slight weakness of the external rectus muscle on the right. Examination of the nose showed a small amount of mucopurulent

9. The disodium salt of 4-sulfamidophenyl-2′-azo-7′-acetylamino-1′hydroxy-naphthalene-3′,6′-disulfonic acid. This is the substance previously known as prontosil soluble and as prontosil.

secretion but no pus in the sphenoethmoid recess. The pharynx was granular and injected. The left ear was normal. The neck was definitely rigid. The deep reflexes were depressed. The corneal reflex was not diminished. The pupils reacted well. There was slight blurring of the nasal margin of both disks in the fundus. An addendum to the history stated that the child was suddenly unable to hear a few days before admission. Examination with the Bárány noise apparatus seemed to show that no hearing was present in the right ear; there was, however, prompt vestibular response on caloric examination.

A spinal tap done on admission showed the fluid to be turbid, under an initial pressure of 360 mm., with 7,200 cells, 90 per cent of which were poly-

Administration of Sulfanilamide in Case 8 (P. K.)

			Sulfanilamide Administered							
Day	Hemoglobin %	Cell Count of the Cerebrospinal Fluid	Per Os, Grains	Intravenously Gm.	Total, Grains	Concentration in the Blood	Concentration in the Cerebrospinal Fluid	Concentration in the Urine	Transfusions	Culture
1		7,200								Positive
2	(Operation)	4,200	30	4.8	104					Positive
3		750	85		85				500	Negative
4	60	1,200	50		50	6.7		190		Negative
5			50		50					Negative
6	71	420	60		60	9.5	7.7	215		Negative
7		380	50		50					Negative
8	70	300	50		50	6.7	Trace	200	500	Negative
9		800	57		57					Negative
10		180	45		45	4.5		143		Positive
11		2,800	52		52					Negative
12		1,400	90	2.4	127					Positive
13	64	1,600	140	2.4	177				400	Negative
14	65	6,000	170	2.4	207	6.3	5.0			Positive
15	55	1,500	200		200	8.7	6.9	116	500	Positive
16	65	4,000	200		200	10.5	8.0		300	Positive
17	69	4,600	250		250	9.7	11.1	157		Positive
18	69	2,750	280		280	12.0	11.5	250		Positive
19		2,500	280		280	13.3	13.3			Positive
20	68	2,400	280		280	13.3				Negative
21	59	650	280		280	9.1			400	Negative
22	68	260	280		280					Negative
23	72	100	265		265					Negative
24	79	50	215		215					Negative
25*	80	none	200		200					Negative

* From the twenty-fifth day of illness to the patient's discharge, on the fortieth day, the dosage of sulfanilamide was diminished to 22½ grains per day, and then it was stopped, as the clinical picture improved.

morphonuclears. No organisms were seen on smear. The Wassermann and Kahn reactions were negative. The impression on admission was that the child had meningitis of otitic origin. With the patient under anesthesia induced by avertin with amylene hydrate, nitrogen monoxide and ether, a simple mastoidectomy was performed. The mastoid seemed moderately sclerotic and filled with diploic bone. No frank pus was visible, but a tremendous amount of softening was found in the initial groove, especially behind the sinus. The squama was removed, exposing the dura of the middle fossa.

Massive doses of sulfanilamide were immediately prescribed, and the child was given repeated transfusions. The spinal fluid contained Str. haemolyticus on admission and on twenty subsequent occasions. The child made a slow but progressive recovery. Nuchal rigidity persisted for a long time after the spinal fluid ceased to show any organism. There was a persistently subfebrile course,

which could not be accounted for by any suppurative focus. In view of this, it was felt that sulfanilamide might be responsible, and when its administration was discontinued, the fever immediately subsided and the temperature stayed down. At the time of the patient's discharge there was no evidence of any residua except slight facial asymmetry and barely perceptible weakness of the right external rectus muscle.

Comment.—Neoprontosil [9] had been administered at the onset of the illness.

The interesting gross findings in the mastoid at operation were probably influenced by the use of sulfanilamide.

Control of meningitis by means of massive doses followed a flare-up during the administration of small doses.

The persistent subfebrile course after apparent recovery from meningitis was unaccounted for by the suppurative focus and promptly controlled by the discontinuance of sulfanilamide therapy.

CASE 9.—In E. G., a 6½ year old boy, following an infection of the upper part of the respiratory tract nineteen days before his admission to the hospital, measles developed. The course was uneventful until ten or eleven days before admission, at which time he complained of pain in the ears. Myringotomy, five or six days later, was followed by a discharge from the ears. Chills or convulsions were not present. At 3 a. m. on the day of admission the child became drowsy and vomited. Drowsiness progressed during the day. The temperature had been 100 to 104 F. during the past week. A cough was not present.

Examination on admission revealed an acutely ill, dehydrated, semistuporous child, in a toxic condition. The pharynx and nose were congested but otherwise did not yield significant observations. The right ear drum was full; landmarks were not visible. There was a small amount of discharge from an anterior perforation, which did not quickly reappear. Tenderness over the mastoid was not present. In the left ear, the drum was full; landmarks were not present; there was an active pulsating discharge from an anterior perforation, and definite tenderness over the mastoid was noted. The heart and lungs were essentially normal, without murmurs. There was slight impairment of response to percussion over the bases of both lungs, suggestive of early bronchopneumonia. Examination of the abdomen revealed that the spleen was not palpable. Neurologic examination showed rigidity of the neck, positive Kernig and Brudzinski signs and depressed reflexes. Examination of the eyes disclosed good extraocular motion, without paralysis; that of the eyegrounds showed congested vessels, without papilledema.

The impression on admission was that the child had meningitis of otitic origin. Culture of material from the ear, blood culture, lumbar puncture and roentgenograms of the mastoids and of the lungs for bronchopneumonia were advised.

Lumbar puncture on admission yielded a fluid containing 2,600 cells, with 78 per cent polymorphonuclears and 22 per cent monocytes. A centrifuged specimen showed no organisms on smear. Roentgen examination showed an infantile mastoid with two or three large cells, without marked destruction. The pulmonary fields showed infiltration of the bases of the lungs. The leukocyte count was 13,300 cells, with 73 per cent polymorphonuclears, 18 per cent of which were nonsegmented, 25 per cent lymphocytes and 2 per cent monocytes. The hemoglobin

content was 78 per cent; Wassermann and Kahn reactions were negative and the urine normal.

The child was immediately given a transfusion of 500 cc. of citrated blood, without immediate reaction.

Bilateral mastoidectomy was performed, with the patient under anesthesia induced by avertin with amylene hydrate and nitrogen monoxide in routine fashion. On the right side, frank pus on removal of the cortex and a moderate amount of periantral sclerosis were found. On removal of the dural plate an epidural abscess was uncapped. No perisinal abscess was observed. A large gush of pus in the region of the zygoma, probably due to a broken-down gland, was seen. The bone was diploic, with three large cells. On the left side, frank pus was found on removal of the cortex. Little cellular structure was noted. No epidural or perisinal abscess was observed. Prior to operation 15 cc. of spinal fluid had been withdrawn. A continuous intravenous infusion of physiologic solution of sodium chloride ran slowly throughout the procedure. Culture of materal from each mastoid yielded Str. haemolyticus.

The child was given massive doses of sulfanilamide, repeated lumbar punctures and repeated small transfusions. Despite intense "cyanosis," administration of sulfanilamide was continued. The child made slow but progressive improvement, and after almost two months made an uneventful recovery.

Comment.—Massive doses of sulfanilamide were given as a preliminary measure for thirty-six hours, because the patient was too ill from otitic meningitis to withstand bilateral mastoidectomy.

Prompt recovery followed mastoidectomy, after prolonged use of smaller doses of sulfanilamide.

Mild acute hemolytic anemia was easily controlled by the proper measures.

CASE 10.—J. R., a 16 year old boy, was admitted to the hospital with a history of having had chronic purulent otitis media on the left for thirteen years. Ten days before admission the patient had an acute exacerbation and two days before admission a temperature of 104 F., with a chill. Blood culture on admission showed Str. haemolyticus. A mastoid was found to be completely destroyed and the wall of the sinus diseased. The lateral sinus was obliterated and the internal jugular vein tied off. Thrombus was not demonstrable. Administration of sulfanilamide, 30 grains (1.9 Gm.) every three hours, was started on admission, after the blood culture was taken, and continued postoperatively. The temperature rose on three occasions to 103 F. and then fell to normal within twelve days and stayed so until discharge.

Comment.—Sinus phlebitis occurred in acute exacerbation of a chronic condition of the ear.

Sulfanilamide was given in massive doses after a blood culture was taken and operation decided on.

CASE 11.—G. B., a 4 year old boy, had a discharge from the ear for three months. Three days before his admission to the hospital he began to vomit, and one day before admission he had a marked swelling behind the ear. On admission there was a foul-smelling discharge through an anterior perforation in the left drum, with marked postaural tenderness and swelling, drowsiness, paralysis of the

left facial nerve, stiffness of the neck and definite evidence of meningitis. Spinal tap showed 13,000 white blood cells; culture showed Bacillus coli. Blood culture showed a minute Str. haemolyticus of Long. Simple mastoidectomy was done, and complete necrosis of the entire mastoid was observed, with the dura covered by greenish yellow exudate, which extended over the entire middle and posterior fossae, and cholesteatoma in the epitympanum. The child was given large doses of sulfanilamide and transfusions but died within two days after operation, of meningitis.

Comment.—B. coli and Str. haemolyticus (minute) of Long were cultured.

The child had been given a "new medicine," in all probability sulfanilamide, for many weeks after the onset of the discharge from the ear.

Case 12.—D. B., a 5 year old child, was admitted to the hospital with a history of fever and headache for two weeks and a thin discharge from the left ear for eight days. Four days before his admission there was marked postaural swelling. On the day of admission, he had a chill and a rise of temperature to 104 F. He was toxic and dehydrated; evidence of bilateral pneumonia was noted; there was an icteric tint to the skin. The right ear drum was essentially normal; the left ear showed an active pulsating discharge and sagging of the wall of the canal. The hearing was impaired, and there was exquisite tenderness over the postauricular area. A blood culture taken on the day of admission was negative. Mastoidectomy was done on the left, with the patient under general anesthesia, and a completely necrotic mastoid was found. The lateral sinus and the dura appeared normal. The immediate postoperative course was eventful, with chills and elevation of temperature to 105 and 106 F. Three days after the simple mastoidectomy, a metastatic focus developed in the left hip, and it was decided to obliterate the left lateral sinus. This was done about two hours before the last blood culture was reported to contain Str. haemolyticus. The internal jugular vein was ligated at that time.

The child was immediately given large doses of sulfanilamide, receiving 20 grains (1.3 Gm.) every three hours day and night. When he was unable to take it by mouth the drug was given intravenously. There was a progressive fall in the hemoglobin content, which was bolstered by repeated small transfusions. Evidence of suppuration of the left hip then developed, and incision and drainage liberated a great deal of pus. The concentration of sulfanilamide in the blood was maintained at 10 mg. per hundred cubic centimeters. The child's general condition improved, and evidence of sepsis completely disappeared. The child one day complained of pain at the tip of his tongue, and a small ulceration appeared. A blood count showed a typical picture of agranulocytosis, with only 1,700 white blood cells, of which 2 per cent were polymorphonuclear leukocytes, 6 per cent eosinophils, 89 per cent lymphocytes and 3 per cent monocytes. Administration of sulfanilamide was immediately stopped, and the child was given repeated transfusions, with a prompt polymorphonuclear response. Aside from toxic hepatitis, which soon disappeared, the child went on to make a complete recovery.

Comment.—This case is interesting because of the complication of agranulocytosis and the toxic hepatitis. Also, sulfanilamide was given only when the diagnosis had been made, and in no way were our clinical indications obscured.

CASE 13.—R. P., an 8 year old child, had had a discharge from both ears for two weeks and presented a history of chills and elevation of temperature to 106 F. on two occasions. He was acutely ill, with a pulsating discharge from the right ear and a less marked one from the left. The eyegrounds showed slight blurring of the nasal side of the disks. Changes in the walls of the canals were not noted. Blood culture on admission showed Str. haemolyticus. Bilateral mastoidectomy was done, and complete destruction of the mastoid was found, with a few granulations on the left sigmoid sinus. Five days later, because of the persistence of septic fever, the left internal jugular vein was ligated and the sinus obliterated. A mural thrombus was found in the bulb. Blood culture again showed organisms before operation. The child was given repeated transfusions and large doses of sulfanilamide orally, intravenously and intramuscularly. The hemoglobin content progressively fell and was bolstered by transfusion. Fifteen days after the second operation the papilledema which was present before the obliteration of the sinus disappeared. The child made an uneventful recovery.

Comment.—Sulfanilamide was given only after the diagnosis was established, and our clinical picture was not masked.

The hemoglobin content progressively fell with the administration of sulfanilamide.

CASE 14.—A. G., a 3 month old infant, had an infection of the upper part of the respiratory tract two weeks before his admission to the hospital, accompanied by discharge from the right ear. The discharge persisted to three days before admission. The day before admission he had swelling behind the right ear.

Examination revealed an acutely ill child. The auricle of the right ear stood away from the head; the canal was narrow and filled with pus. The drum was poorly visualized. Postauricular swelling and periosteal thickening were noted. The left ear was normal.

Simple mastoidectomy was performed on the right. A subperiosteal abscess was found, with multiple cortical perforations. The cavity of the mastoid was completely destroyed. The sinus and the dura were not exposed. Culture of the pus revealed Pneumococcus type V. On the day after the operation the temperature rose to 105 F., which was considered a reading to be expected postoperatively, but the fever persisted from then on, ranging between 101 and 105 F., with days of sustained fever. Three days after operation, the patient showed evidence of increased intracranial tension, i. e., bulging of the fontanel, stiffness of the neck and Brudzinski's and Kernig's signs, without nystagmus. The chest appeared clear clinically and roentgenologically. A lumbar puncture at that time showed cloudy fluid, with a 4 plus Pandy reaction, 1,260 cells, 90 per cent of which were polymorphonuclears, gram-positive cocci in chains and a negative reaction for sugar; according to Neufeld's typing, the spinal fluid contained Pneumococcus type V.

The child was given repeated lumbar punctures and 2½ grains (0.16 Gm.) of sulfanilamide every four hours night and day for twenty-four hours. Sulfanilamide was given in increasing doses up to 30 grains (1.9 Gm.) per day. Blood culture four days postoperatively showed Pneumococcus type V. Antipneumococcus serum type V was given intrathecally on eight successive days, a total of 117,500 units.

Repeated lumbar punctures showed increased pressure and an increase in cells and organisms. Concentrations of sulfanilamide were raised to 10.5 mg. per hundred cubic centimeters. There was a slight drop in temperature, but this

was transitory. The question of abscess of the brain arose, but neurosurgeons did not see any indications for an intracranial operation. A ventricular tap with injection of serum was ineffectual, and the child died twenty-five days after admission. Permission for autopsy was not obtained.

Comment.—The course (25 days) of otitic meningitis due to Pneumococcus type V in a 3 month infant was much prolonged under treatment with sulfapyridine.

CASE 15.—In B. B., a 7 year old child, influenzal otitis media developed during the course of an infection of the upper part of the respiratory tract. Two days later spontaneous rupture of the drum occurred. The temperature ranged between 100 and 101 F. for a few days, and a thin discharge from the middle ear became profuse. Administration of sulfanilamide, 40 grains (2.6 Gm.) daily, was begun one week from the onset of the otitis and continued for six days. The discharge from the middle ear soon stopped and the beginning of resolution was noted. The temperature returned to normal, and the general condition was excellent. It was decided to discontinue the administration of sulfanilamide because of knowledge of a possible masking effect of the drug. Thirty-six hours after the administration of sulfanilamide was stopped, the middle ear began to discharge profusely; the discharge was thicker than it had been at any time, and the drum had a "boggy" appearance. Tenderness over the mastoid increased, and the patient had spontaneous aural pain. The temperature ranged between 99 and 100 F. After forty-eight hours of observation during which the local manifestations increased in severity, it was decided that mastoidectomy was indicated. Operation disclosed free pus and granulations, with areas of softening throughout an unusually large mastoid. Hemolytic streptococci were cultured from pus from the mastoid.

Comment.—A latent or quiescent period during the administration of the drug was shown. This case illustrates the importance of careful observation of patients who are given sulfanilamide during the course of otitis media and the diagnostic value of withdrawal of the drug, to determine whether apparent improvement is only a masking effect.

SUMMARY AND CONCLUSIONS

The use of sulfanilamide has resulted in a genuine advance in the treatment of certain otogenous infections.

Eradication of the otitic focus is of paramount importance.

Indiscriminate use of the drug may obscure the diagnosis or result in masked or latent involvement of the mastoid.

With sulfanilamide therapy, the usual clinical course of an otitic complication may be modified.

Massive doses in the earlier stages, controlled by determinations of the concentration in the blood, have given the best results.

Indications for administration are discussed, and illustrative cases are cited.

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ORIGIN OF THE QUICK COMPONENT OF LABYRINTHINE NYSTAGMUS

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The mechanism of one of the most striking clinical phenomena, the rhythmic ocular movements appearing on stimulation of the labyrinth, is still a controversial subject. For many years clinicians have tried to localize a "center" of the fast component of nystagmus. It is perhaps appropriate to state the problem in another way, that is to ask on the intactness of which parts of the central nervous system the genesis of rhythmic reaction of the ocular muscles to labyrinthine stimulation depends. The theories put forth in an attempt to answer this question may be divided as follows (Spiegel [1] and Spiegel and Sommer [2]):

I. The cerebral theory, which attributes the function to the parts of the central nervous system above the midbrain.

II. Theories assuming that the origin of the rhythm is in parts of the vestibulo-ocular reflex arc.

The various theories of group II may be enumerated as follows:

1. The proprioceptor theory, which assumes that the rhythmic reaction is due to proprioceptive impulses from the ocular muscles.

2. The ocular muscle nuclei theory, which locates the origin of the rhythm in the nuclei of the motor nerves to the ocular muscles. The assumption is that there is a mutual inhibition of the oculomotor nuclei.

3. The labyrinthine theory, which seeks the origin of the rhythm in the labyrinth.

4. The vestibular nuclei theory, which attempts to localize the origin of the rhythm in the vestibular nuclei.

5. The reticulate substance theory, which localizes the origin of the rhythm in the substantia reticularis rhombencephali.

The cerebral theory is refuted by the failure of the elimination of the prosencephalon and the diencephalon to prevent the appearance of

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Read at a meeting of the Philadelphia Laryngological Society, March 7, 1939.
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1. Spiegel, E.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **25**:200, 1929.

2. Spiegel, E. A., and Sommer, I.: Ophthalmo- und Oto-Neurologie, Berlin, Julius Springer, 1931. Here also further references may be found.

nystagmus on labyrinthine stimulation (Bauer and Leidler [3] and Magnus and de Kleijn [4]).

The proprioceptor theory is refuted by the production of nystagmus when the proprioceptors have been paralyzed by the injection of procaine hydrochloride into the ocular muscles (de Kleijn [5]).

The ocular muscle nuclei theory is refuted by the failure, when only one oculomotor nucleus remains connected with the vestibular nuclei, of the internal rectus muscle innervated by the opposite third nucleus to contract rhythmically on labyrinthine stimulation (Spiegel [1]). This shows that the mutual connections of the two oculomotor nuclei are unable to produce the rhythm.

The labyrinthine theory is refuted by the failure of elimination of both labyrinths to prevent nystagmus of central origin [6] (Bechterew's compensatory nystagmus or nystagmus following punctures of the vestibular nuclei [Spiegel and Sato [7]]).

Thus the problem is restricted to the alternative between the vestibular nuclei theory (II_4) and the reticulate substance theory (II_5). A participation of the reticulate substance in the conduction of the labyrinthine impulses to the nuclei of the ocular muscles is indicated by the experience that severance of the posterior longitudinal fasciculus does not prevent nystagmus when the labyrinth is stimulated (Lorente de Nó [8] and Spiegel [1]). Yet, after he had produced large lesions of the reticulate substance [9] by puncturing the brain stem from the ventral aspect, thus avoiding lesions of the vestibular fibers entering the posterior longitudinal fasciculus, Spiegel [1] still observed nystagmus with both components on rotation. He therefore inclined toward the vestibu-

3. Bauer, J., and Leidler, R.: Arb. a. d. neurol. Inst. a. d. Wien. Univ. **19:** 155, 1912.

4. Magnus, R., and de Kleijn, A., in Alexander, G., and Marburg, O.: Handbuch der Neurologie des Ohres, Berlin, Urban & Schwarzenberg, 1923, vol. 1, p. 465.

5. de Kleijn, A.: Arch. f. Ophth. **107:**480, 1922.

6. In these cases both phases of the nystagmus are of course of central origin, as Dusser de Barenne (Handbook of General Experimental Psychology, edited by C. Murchison, Worcester, Mass., Clark University Press, 1934, p. 210) pointed out. This does not, however, invalidate the conclusion that the labyrinths are not a necessary part of the mechanism producing the rhythm.

7. Spiegel, E., and Sato, G.: Arch. f. d. ges. Physiol. **215:**106, 1926.

8. Lorente de Nó, R.: Die Labyrinthreflexe auf die Augenmuskeln, Berlin, Urban & Schwarzenberg, 1928.

9. In some experiments (Spiegel,[1] fig. 3) the lesion (hemorrhage and surrounding edema and necrosis) reached close to the posterior longitudinal fasciculus. The objection that the lesion was not sufficient is therefore hardly justified.

lar nuclei theory, while Lorente de Nó,[10] observing disturbances in the ocular reactions to labyrinthine stimulation and also loss of the quick component (tonic deviation only) after puncturing the reticulate substance from the dorsal aspect, stated that these experiments indicate that cell groups outside the vestibular nuclei, in particular parts of the reticulate substance, are responsible for the production of the rhythm. In view of the importance of Lorente de Nó's observations for our problem, it seemed desirable to continue experiments in this direction, particularly not to limit the observations, as Lorente de Nó did, to the acute stage following operation but to observe the further course of the changes in the ocular reaction following labyrinthine stimulation.

METHOD

The operation on the floor of the fourth ventricle was performed on cats under anesthesia induced by pentobarbital sodium. A catheter was introduced into the trachea during operation, so that artificial respiration could be quickly performed if necessary after the medulla was punctured. The floor of the fourth ventricle was exposed in the usual way: The posterior atlanto-occipital membrane and the adjacent parts of the occipital bone were removed, and the cerebellum was gradually elevated. The incision was made in or close to the midline of the fossa rhomboidalis with a thin, double-edged knife. This operation did not interrupt spontaneous respiration in some of the experiments, but in others artificial respiration was necessary from one-half to one hour.

The labyrinth was stimulated by rotation, by galvanic stimulation (one electrode in each external meatus) and by caloric stimulation. For the latter purpose cold water was conducted through a U-shaped metal cannula that was introduced into the external meatus.

RESULTS AND COMMENT

Two types of lesion may be distinguished:

1. Paramedian punctures affecting not only the reticulate substance but also fibers from the ipsilateral vestibular nuclei into the posterior longitudinal bundle or lesions through this bundle, which sometimes involved also the nucleus or roots of the sixth nerve.

2. Median (middle line) incisions, leaving the posterior longitudinal fasciculus intact and severing only the fibers crossing in the raphe.

The following experiments may illustrate the first type (paramedian lesions):

Cat 1.—On Feb. 15, 1938, an incision was made into the floor of the fourth ventricle with the animal under anesthesia induced by pentobarbital sodium. Spontaneous respiration continued after operation.

On February 16 the animal lay on the left side and was able partly to raise the head. The head showed a tremor, and the cat could sit up partly and move

10. Lorente de Nó, R.: Vestibulo-Ocular Reflex Arc, Arch. Neurol. & Psychiat. **30**:245 (Aug.) 1933.

it to either side. There was slight deviation of the eyeballs to the left but no spontaneous nystagmus. The longitudinal diameter of the right pupil was rotated 5 degrees outward and that of the left pupil 17 degrees inward.

The results of rotation were as follows:

10 rotations to right	No nystagmus
10 rotations to left	Increased deviation of right eye to left (inward); eye remains for ½ minute in this position
10 rotations to right	Distinctly decreased deviation to left of right eye, followed by 7 to 8 horizontal undulations without a discernible fast or slow component.
10 rotations to left	Tonic deviation to left and nystagmus with small amplitude to right, particularly distinct in right eye.

Galvanic stimulation with electrodes in both external auditory meatuses produced the following reactions:

Cathode in left meatus (5 ma.)	Distinct coarse nystagmus to left
Cathode in right meatus (5 ma.)	Only deviation of eyes to left; no nystagmus
(8 ma.)	Deviation to left and few jerks of small amplitude to right

On February 18 spontaneous vertical nystagmus was present (20 jerks per minute). Repeated rotation with the head in the normal position produced the following results:

10 rotations to right	22 jerks to left in 12 to 13 seconds
10 rotations to the left	27 to 33 jerks to right in 14 to 17 seconds

With the head fixed in a side position (right ear up), the eyes were spontaneously deviated downward (to the lower lid); vertical nystagmus to the upper lid was diminished to 2 jerks of small amplitude per minute, and rotation produced the following results:

10 rotations to left	29 jerks downward in 17 seconds.
10 rotations to right	5 weak jerks upward in 14 seconds

With the head fixed in a side position (left ear up), spontaneous nystagmus occurred in groups of jerks, partly beating toward the lower lid (16 jerks per minute) and partly beating toward the left canthus (10 jerks per minute), and rotation produced the following results:

10 rotations to right	46 coarse jerks downward in 23 seconds
10 rotations to left	8 jerks upward and somewhat to the left in 14 seconds

Summary.—One day after the operation, rotation elicited only tonic deviation; later, rotation to the right produced undulation without a discernible fast or slow component, and rotation to the left produced nystagmus to the right with a

small amplitude. By galvanic stimulation (5 milliamperes) nystagmus to the left, and with somewhat stronger current (8 milliamperes) also to the right, could be elicited. Three days after the operation distinct horizontal nystagmus to the left, as well as vertical nystagmus (up and down), could be elicited by rotation.

Histologic Examination.—The incision started on the floor of the fourth ventricle between the right posterior (medial) longitudinal fasciculus and the right knee of the facial nerve. It took its course inward from and parallel to the roots of the right sixth nerve; more cranially it transversed the corpus trapezoideum, and on sections through the anterior part of the pons it reached the ventral surface after passing through the pyramidal tract.

Cat 2.—On March 1, 1938, an incision was made into the floor of the fourth ventricle with the animal under anesthesia induced by pentobarbital sodium.

On March 2 the cat could sit up but had ataxic movements of the head. Spontaneous nystagmus was present (occasional vertical jerks, sometimes upward and sometimes downward).

Repeated rotation with the head in the normal position produced the following results.

10 rotations to right	23 to 24 distinct jerks to left in 16 to 20 seconds
10 rotations to left	In some experiments, only fine tremor of the eyeballs; in some, jerks to right and upward with small amplitude (16 jerks in 15 seconds)

With the head fixed in a side position (right ear down) distinct spontaneous nystagmus toward the lower lid was present.

With the head fixed in a side position (left ear down), occasional spontaneous vertical nystagmus toward the upper lid occurred, and rotation produced the following results:

10 rotations to right	10 jerks to upper lid in 8 seconds.
10 rotations to left	19 jerks to lower lid in 15 seconds

On March 3 the cat could sit and stand; the head was slightly turned to the right, and a slight tendency to fall to the right was present.

With the head in the normal position, no spontaneous nystagmus occurred, and rotation produced the following results:

10 rotations to right	26 jerks to left and downward in 18 seconds
10 rotations to left	In 1 experiment, no definite nystagmus; in another, 5 horizontal undulations with small amplitude; in further tests, 18 to 22 jerks downward in 17 to 22 seconds

With the head fixed in a side position (left ear down) spontaneous nystagmus to the lower lid was present (60 jerks in 30 seconds).

With the head fixed in a side position (right ear down), spontaneous nystagmus to the lower lid was present (57 jerks in 30 seconds), and rotation produced the following results:

10 rotations to right	Frequency of spontaneous nystagmus increased
10 rotations to left	Inhibition of spontaneous nystagmus for 15 seconds; 1 to 2 jerks to upper lid, followed by reappearance of spontaneous nystagmus

Galvanic stimulation with electrodes in both external auditory meatuses produced the following reactions:

Cathode in right meatus (8 ma.)	9 jerks of small amplitude to right in 30 seconds
Cathode in left meatus (5 ma.)	36 to 58 distinct jerks to left in 30 seconds (fig. 1)
Cathode in right meatus (9 ma.)	11 jerks downward and slightly to right in 30 seconds.

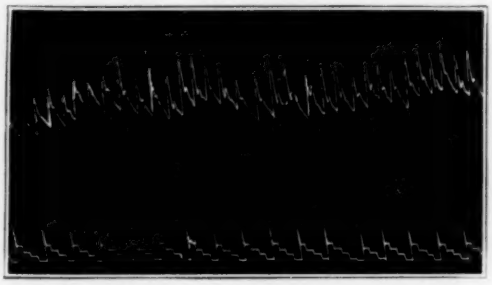

Fig. 1 (cat 2).—Galvanic nystagmus (anode in the right and cathode in the left external auditory canal). Upward lines in the graph represent ocular movements to the left. The lower lines indicate time in seconds.

With the head in the normal position, spontaneous vertical nystagmus upward was present (5 to 10 jerks in 30 seconds), and rotation produced the following results:

10 rotations to right	Horizontal undulations (15 jerks in 19 seconds)
10 rotations to left	Eyes deviated somewhat downward; nystagmus upward and rotary to right (5 jerks)
10 rotations to left	4 to 5 rotary jerks to right in 17 seconds

Caloric stimulation produced the following reactions:

Cold water irrigation (left ear)	Vertical nystagmus upward (16 jerks in 1 minute)
Hot water irrigation (left ear)	Vertical nystagmus upward (22 jerks in 1 minute)
Spontaneous nystagmus	6 to 15 jerks in 1 minute (upward)
Cold water irrigation (right ear)	Nystagmus to left (36 jerks in 30 seconds, some of jerks upward)

Hot water irrigation (right ear)	Deviation downward and somewhat to left; 5 upward jerks of large amplitude per minute
Spontaneous nystagmus	4 upward jerks of small amplitude per minute

On March 8, with the head in the normal position, spontaneous slow upward and downward movements of the eyeballs occurred, and rotation produced the following results:

10 rotations to right	Nystagmus to left (12 to 15 jerks in 7 to 15 seconds)
10 rotations to left	11 jerks rotary to right
10 rotations to left	12 jerks down and rotary to left
10 rotations to left	Tonic deviation downward and single jerk to right; sometimes only downward deviation

With the head fixed in a side position (left ear down) rotation produced the following results:

10 rotations to right	7 jerks to upper lid in 10 seconds
10 rotations to left	6 jerks to lower lid in 8 seconds

The cat died during the night of March 8 to March 9.

Summary.—The lesion produced spontaneous vertical nystagmus (mostly upward but sometimes downward).

Rotation: Nystagmus to the left could be elicited as early as one day after the operation. Nystagmus to the right could be produced rather rarely; on the first day after operation it had a small amplitude, but also in the following days it was impaired, easily exhausted and replaced by vertical nystagmus. Vertical nystagmus in either direction could well be produced.

Galvanic Stimulation: Distinct nystagmus to the left could be produced. Nystagmus to the right appeared on application of strong currents (8 to 9 ma.) only; it had a smaller amplitude and a lower frequency and was easily exhausted, after which downward nystagmus became manifest.

Caloric Stimulation: Irrigation of the left ear with cold as well as with hot water produced only an increase of the spontaneous upward nystagmus. Irrigation of the right ear with cold water elicited distinct nystagmus to the left; on irrigation of this ear with hot water deviation downward and to the left appeared. Nystagmus to the right could not be elicited. Thus the impairment of the nystagmus to the right was most marked on caloric stimulation.

Histologic Examination.—A paramedian incision on the right side entered the floor of the fourth ventricle through and immediately in front of the right sixth nucleus. The right posterior (medial) longitudinal fasciculus was destroyed by the lesion except for its most medial fibers (fig. 2 *A*). Also the systems ventrally adjacent to the posterior longitudinal fasciculus were destroyed. The puncture coursed through the reticulate substance in a ventrocranial direction, remaining in a paramedian position and parallel to the raphe and dividing into two punctures above the pyramidal tracts, at the level of the decussation of the trochlear nerve. The lesions lay on the medial border of the pyramidal tract in the level of the posterior quadrigeminal bodies (fig. 2 *B*). On the left side a small hemorrhage was noted between the knee of the roots of the facial nerve and the substantia gelatinosa of the fifth nerve.

It is conceivable that the lesion in cat 2, affecting the right sixth nucleus and also the ipsilateral posterior longitudinal fasciculus and the ventrally adjacent vestibulomesencephalic tracts, impaired the nystagmus to the right side, which was easily exhausted yet not completely lost, for by rotation and galvanic stimulation it could still be elicited with small amplitude, while caloric stimulation failed to produce it, producing instead reactions in a vertical direction (increase of a spontaneous upward nystagmus or deviation to the left and downward). It is of interest to compare the reactions of this animal with those of cat 1, in which the lesion was located between the right posterior longitudinal fasciculus and the knee of the roots of the facial nerve, then coursing

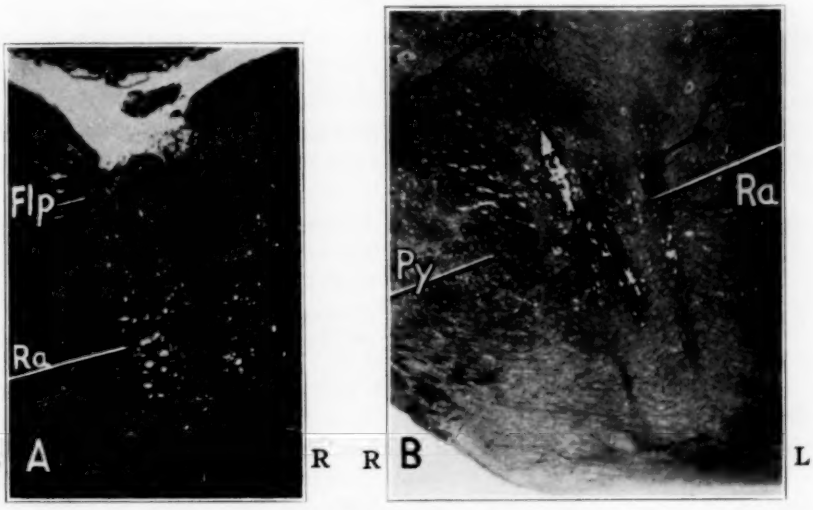

Fig. 2 (cat 2).—*A*, section through the pons in front of the sixth nucleus. *B*, section through the posterior corpora quadrigemina. *Flp* indicates the fasciculus longitudinalis posterior; *Py*, the pyramidal tract; *Ra*, the raphe; *R*, right, and *L* left.

medially to the roots of the sixth nerve; here only in the first days after operation were difficulties in the production of nystagmus encountered, and as early as three days after operation rotation produced horizontal as well as vertical nystagmus in either direction.

Still more important for our problem is the second type of lesion, the exactly median incision, illustrated in the following experiment:

CAT 3.—On March 15, 1938, incision was made in the median sulcus of the rhomboid fossa, with the animal under anesthesia induced by pentobarbital sodium; no disturbance of respiration occurred.

On March 16, with the head in the normal position, the animal showed no spontaneous nystagmus, and rotation produced the following results:

10 rotations to right	Slight deviation of eyeballs to right; no nystagmus
10 rotations to left	Distinct deviation of eyeballs to left; no nystagmus

With the head fixed in a side position (left ear down), no definite spontaneous nystagmus but a fine tremor of the eyeballs was present, and rotation produced the following results:

10 rotations to right	1 jerk to upper lid, followed by 10 jerks of small amplitude toward right canthus, with slight component upward
10 rotations to left	5 jerks of small amplitude toward lower lid
10 rotations to right	15 jerks upward (first two of large amplitude, subsequent ones of small amplitude)

With the head fixed in a side position (right ear down), spontaneous nystagmus toward the lower lid was present (20 jerks of small amplitude per minute), and rotation produced the following results:

10 rotations to right	Amplitude of spontaneous nystagmus somewhat increased; frequency, 12 jerks in 20 seconds
10 rotations to left	5 jerks toward upper lid, followed by reappearance of spontaneous nystagmus

Galvanic stimulation with electrodes in both external auditory meatuses produced the following reactions:

Cathode in left meatus (8 ma.)	Deviation of eyeballs to right; minimal nystagmus (small amplitude) to left
Cathode in right meatus (8 ma.)	Deviation of eyeballs to left; somewhat more distinct nystagmus to right and slightly upward.

On March 17, with the head in the normal position, no spontaneous nystagmus was present, and rotation produced the following results:

10 rotations to right	3 distinct jerks to left; tonic deviation to right outlasting these jerks; duration of whole reaction, 23 seconds
10 rotations to left	10 jerks to right in 16 seconds
10 rotations to right	6 jerks to left in 19 seconds

With the head fixed in side position (right ear down), spontaneous nystagmus to the left canthus was present (22 jerks in 30 seconds), and rotation produced the following results:

10 rotations to right	12 jerks toward lower lid in 14 seconds
10 rotations to left	12 vertical jerks in 24 seconds, first toward upper, then toward lower, lid

10 rotations to left	17 vertical jerks in 20 seconds (first 3 toward upper, then 4 toward lower, then again toward upper, lid)

Galvanic stimulation with the electrodes in both external auditory meatuses produced the following reactions:

Cathode in right meatus	Distinct nystagmus to right (18 jerks per minute)
Cathode in left meatus	Nystagmus to left with component upward (30 jerks per minute)

The nystagmus was much more distinct (larger amplitude) than on the previous day.

Summary.—One day after the lesion, rotation produced only horizontal deviation of the eyeballs but failed to produce horizontal nystagmus in either direction. Vertical nystagmus, upward as well as downward, could be elicited. Galvanic stimulation was able to produce nystagmus with small amplitude to the left and more distinct nystagmus to the right.

Two days after operation, rotation produced horizontal as well as vertical nystagmus, and the horizontal nystagmus on galvanic stimulation had a larger amplitude than on the previous day.

Histologic Examination.—The incision started behind the sixth nucleus, at the level of the triangular nuclei and the cochlear ganglions (fig. 3 *A*), it lay exactly in the median line separating the posterior longitudinal fasciculi of either side. A section through the sixth nucleus and the knee of the roots of the facial nerve showed the puncture exactly in the raphe (fig. 3 *B*), reaching close to the corpus trapezoideum and separating the right and the left reticulate substance from each other. In the most cranial part of the pons, the lesion, which still extended dorsally to the corpus trapezoideum, deviated slightly from the median line. At the level of the descussation of the roots of the fourth nerve it lay between the medial lemnisci and the pyramidal tracts of either side. Its ventral end lay between the pyramidal tracts at the level of the inferior colliculi (fig. 3 *C*).

There were hemorrhages and necrosis in the ventrocaudal part of the vermis cerebelli.

In this case the puncture severed just those fibers which are according to Lorente de Nó [10] of importance for the production of the quick component (of the rhythm) of nystagmus.[11] He wrote:

> . . . a longitudinal lesion cutting the pathways which cross the middle line between the level of the oral end of the motor nucleus of the trigeminus and the level of the caudal end of the tuberculum acusticum is enough to change the rhythmic nystagmus into a pseudopostural reflex.

He stated that particularly the pathways crossing the middle line at the level of the anterior third of the sixth nucleus are of great importance.

11. Lorente de Nó's experiments were performed on rabbits, but the conclusions drawn from these experiments should, of course, be applicable to other mammals too.

Yet despite the cutting of these fibers we found that only on the first day after operation did rotation fail to elicit the rhythmic reaction producing instead tonic deviation of the eyeballs. As soon as two days after operation rotation produced not only vertical but also horizontal nystagmus in either direction. The galvanic nystagmus had a small

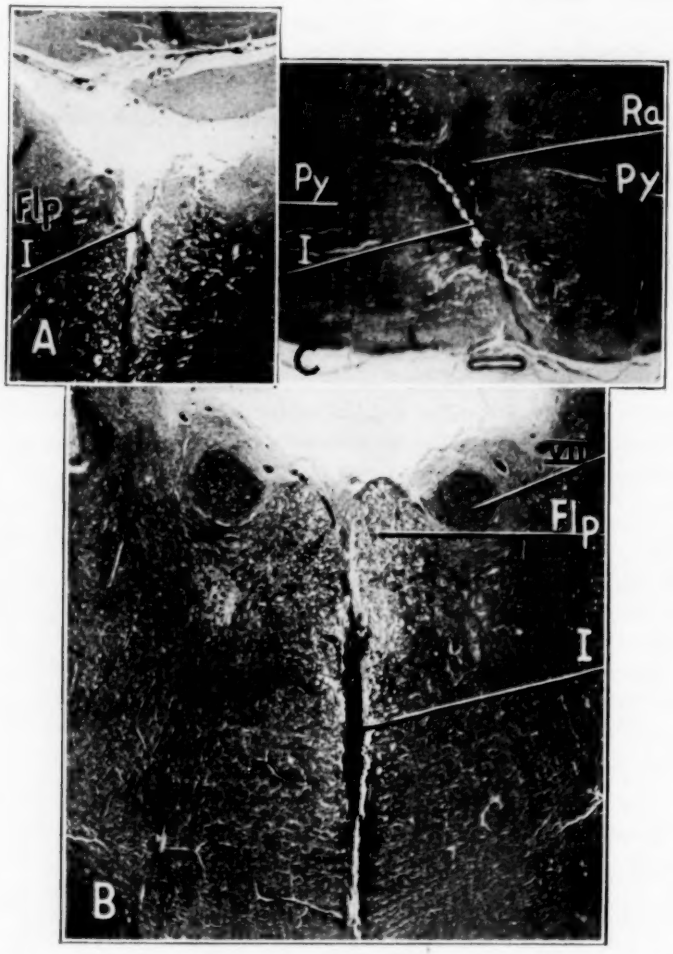

Fig. 3 (cat 3).—*A*, section through the anterior end of the medulla oblongata behind the sixth nucleus. *B*, section through the pons at the level of the sixth nucleus and the knee of the root of the seventh nerve. *C*, section through the posterior corpora quadrigemina. *Flp* indicates the fasciculus longitudinalis posterior; *I*, the incision; *Py*, the pyramidal tract; *Ra*, the raphe, and *VII*, the knee of the root of the facial nerve.

amplitude on the first day after operation, but was much more distinct (larger amplitude) on the second day.

CONCLUDING OBSERVATIONS

Reviewing these experiments, we may first confirm the observation of Lorente de Nó that punctures into the reticulate substance and the raphe of the rhombencephalon, respectively, from the floor of the fourth ventricle may induce disturbances in the ocular reactions on labyrinthine stimulation, so that in an initial postoperative stage tonic deviation of the eyeballs is elicited instead of the rhythmic reaction. Reactions in a false direction also may be observed. The difficulty in producing the rhythmic reaction is particularly pronounced on caloric stimulation, probably because it is rather weak.

However, if the animals are examined beyond the acute stage, one finds, especially if concomitant lesions of the posterior longitudinal fasciculus system and of the nucleus and roots of the sixth nerve are avoided, that these disturbances are reversible to a great extent and that rhythmic ocular reactions may reappear.

Particularly on stimulation by rotation and by galvanic current, as early as a few days after operation horizontal nystagmus (to the left as well as to the right) and vertical nystagmus (up as well as down) can be produced, beating in the proper direction according to the stimulus applied. In seeking the origin of the rhythm one has, therefore, to bear in mind that the suppression of the rhythm observed after puncture of the reticulate substance and of the raphe, respectively, is only short-lived. The finding that lesions outside the vestibular nuclei affecting the reticulate substance may prevent the formation of the rhythmic response on labyrinth stimulation can hardly be used as an argument against the vestibular nuclei theory and in favor of the reticulate substance theory, in view of the transitory nature of the disturbance. It should also be pointed out that disturbance of the equilibrium between the centers of the left and the right side produced by punctures of the reticulate substance without lesion of the fibers from the vestibular nuclei to the fasciculus longitudinalis posterior does not result in such symptoms of spontaneous nystagmus as are observed after puncture of the vestibular nuclei; such spontaneous nystagmus should be expected if the rhythm originated in the reticulate substance. Thus, there seems to exist no proof that the rhythm of nystagmus originates in the reticulate substance, lesions of this region either not destroying the rhythm at all (former experiments of Spiegel [1]) in which the brain stem was punctured from the ventral aspect or disturbing it only transitorily (present series of experiments). Since all other possibilities also were excluded, as pointed out in the introductory survey, there remains only the possibility that the rhythm takes its origin in the vestibular nuclei. It should be emphasized that the experiments reported in this paper and the conclusions based on these experiments do not invalidate the view

that an important bypath for the conduction of labyrinthine impulses to the ocular muscles takes its way through the reticulate substance. Lorente de Nó is to be credited with having first demonstrated the existence of this bypath.

SUMMARY

The effect of punctures of the reticulate substance and also punctures in the raphe of the rhombencephalon on ocular reactions following stimulation of the labyrinth was studied by experiments on cats, with special reference to the restitution of function.

The suppression of the rhythmic reaction (substitution of tonic deviation) found in the acute experimental stage subsides in the first few days after operation, so that again rhythmic ocular reactions with a slow and a quick component are obtained on labyrinthine stimulation (particularly rotation and galvanic stimulation). These observations seem to support the view that the reticulate substance is not indispensable in the mechanism of nystagmus and that the origin of the rhythm must be in the vestibular nuclei.

HEADACHE FROM PATHOLOGIC CHANGES IN THE NOSE OR OTHER CAUSES

DIFFERENTIAL DIAGNOSIS

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Headaches or neuralgias which are really secondary to or dependent on pathologic changes in the nose and sinuses should not offer great difficulties in differential diagnosis, certainly not in the practice of the members of the American Laryngological Association.

Headaches or neuralgias from other causes may offer abundant difficulties in differential diagnosis to members of this special group or to other physicians, especially if a careful history, family and personal, is not given precedence over physical findings and roentgen evidence.

To limit the field of discussion, I choose to consider under "other causes" only those headaches or neuralgias, with associated symptoms, which appear periodically for months or years or most of a lifetime in the ambulatory or ordinary office patient. Such patients usually carry on most of their regular duties and enjoy good health except for short periods of marked discomfort. Real pathologic changes in the face or head, or elsewhere in the body, for that matter, are usually not the main consideration. In most instances only subjective symptoms are present, with no objective evidence to further a diagnosis. Transient disturbances of vasomotor origin in the brain, meninges, ganglions or nerve sheaths, whether spoken of as migrainous, allergic or functional upsets, are responsible for the symptom complex in most instances.

If otolaryngologists practice their specialty first as physicians, they will be truly interested in the symptoms brought forth by a careful history; if, however, they practice purely as specialists in the field of otolaryngology, they may be blinded by physical signs and roentgen evidence, which can, and often do, confuse rather than clarify differential diagnosis. Most of the periodic headaches, especially those with associated general symptoms, mild or severe, which are encountered in everyday office practice are not due to local irritation of the nerve ends in the nose, sinuses, teeth or eyes. They are more likely to be due to circulatory changes of some type in the brain, meninges, ganglions or

Read at the Sixty-First Annual Meeting of the American Laryngological Association, Rye, N. Y., May 24, 1939.

nerve sheaths. These circulatory changes are as general in nature as are those in arteriosclerosis, asthma and many conditions involving the skin or the gastrointestinal tract. The fact that the symptoms, headache and neuralgia, though subjective, are closely associated anatomically with objective evidence of pathologic changes in the nose or of sinal disease leads to many errors in diagnosis.

There is a function for small specialized groups in the study of special problems in the diagnosis of the various ills which beset the human race, but there is, in my opinion, an equally good and more sufficient reason why such specialists should rule out first the general problems which are constantly complicating the specialized fields of practice. It seems reasonable to express the opinion that in many of the meetings of otolaryngologists and in much of their literature too much stress is placed on rare conditions and cases in which difficulties occur and too little is said of what is done about everyday problems in everyday practice. Most of the otolaryngologist's patients come to him because he is a Doctor of Medicine; they naturally assume that his horizon is not limited by any artificial divisions of their bodies or of his medical thinking.

In many instances the diagnosis of the probable cause of periodic headache or neuralgia and associated symptoms depends to a great extent on the specialty of the physician who examines the patient. Migraine as a dramatic syndrome of vasomotor, allergic or functional origin is protean in type. The visual symptoms, such as scintillating scotomas or hemianopia, usually take the patient to the ophthalmologist; the frontal headache, bone tenderness and nasal symptoms suggest the otolaryngologist; nausea and vomiting call for a surgeon to consider the appendix or gallbladder; paresthesia, transient aphasia or amnesia interest the neurologist; the high incidence of the syndrome in women and the common relation of the attacks to the menstrual period and the menopause allow the gynecologist to consider the possibility of endocrine treatment or pelvic operation to relieve possible reflex irritation. Physicians who have never been subject to headache rarely take any particular interest in the associated symptoms, so indicative of involvement of the cortex of the brain. To them such complaints are simply evidence of "nervousness" and are rarely given careful consideration.

Given a symptom complex with such unlimited possibilities for surgical or other treatment in any of the special fields of the practice of medicine and given the type of patient who has usually a long span of life with good health between the attacks of the disease and the attacks of those who would relieve it, I am reminded of the statement so seriously made to me by my mother in my youth: "Remember, son, your body is fearfully and wonderfully made."

I wish to make clear that the statements made in this paper are based mainly on personal observations during the past seventeen years and that many of these statements disagree essentially with those made by some writers who class as authorities. Though I may disagree, I intend never to belittle the beliefs or ideas of other physicians. Progress in any field of scientific endeavor must be made by stumbling ahead over some fallen bricks originally placed by older and equally conscientious workers. My particular interest in the differential diagnosis of the principal causes of periodic headache and associated symptoms dates to my personal experience as a victim of migraine and not to the completion of academic work in medical school or of postgraduate studies in otolaryngology. During the years in which I have been particularly interested in the problems of periodic familial headache, I have marveled at the little stress placed on the prevalence and the symptoms of this condition in medical schools and postgraduate courses. Students, interns and practitioners in conversations in the hotel room or lobby often give the impression that I have discovered a new and rare condition. Actually it is estimated by authorities that from 5,000,000 to 9,000,000 victims of migraine are now living in the United States.

Careful study of the voluminous writings concerning these vasomotor outbursts, I am loath to say, but must say to be true to my subject and myself, has caused much disappointment and discouragement as to the value of quantities of the recorded literature. The records have been for hundreds of years and are now replete with glowing descriptions of methods which have relieved periodic attacks of headache or neuralgia of probable vasomotor origin, with associated symptoms, but little has been said as to whether the treatments given or operations done have prevented the recurrence of similar attacks. Listing from the literature the many causes of periodic vasomotor headache and the treatments advised makes one realize that this is a condition closely related to hay fever and asthma in more ways than one. Every one knows that throughout the years many enthusiastic reports of procedures advocated to relieve or cure various allergic conditions have had to be discarded after sufficient time has elapsed to allow for the recurrence of the symptoms.

It has been my experience, and I am sure it will be that of the reader, if he carefully follows for long periods patients who give symptoms of migraine or some type of vasomotor headache or neuralgia, that more of them lose their symptoms *spontaneously* than after all treatments and operations combined. There is no doubt that many of these spontaneous or natural cures are credited to some treatment or operation which they follow because of coincidence. Just getting older accounts for more cures than all treatments and operations. Rarely does a patient over

60 go to a physician with the complaint of headache. Headache and neuralgia, of course, are purely subjective symptoms, and knowledge of their probable type and possible severity must depend to a great extent on the individual patient's intelligence or ability to express himself. The term "headache," as the patient uses it, may describe a real pain, a peculiar sensation, a feeling of pressure or a purely psychic disturbance. It may at times express purely a defense reaction or be used as a basis for a claim in litigation.

MECHANICS OF HEADACHE

Much has been written but little is actually known concerning the actual mechanics or pathologic process of the production of headache or neuralgia. It is known that there are nerves of sensation in the dura, but there are supposed to be none in the pia or the arachnoid. Stretching of the dura gives pain, as can easily be demonstrated at operation. Some experimental work has demonstrated that nerves of sensation are found only around the blood vessels. The mechanism of the production of the pain and associated symptoms in migraine is supposed by some to be explained by alterations in the pressure of cerebrospinal fluid in the basal cisterna. Practically, for the purpose of this paper, it seems reasonable to assume that local tissue reactions in the brain substance, meninges, ganglions or nerve sheaths, similar to the local tissue reactions of urticaria or angioneurotic edema, may explain the regular progression of the pain and associated cortical symptoms in migraine or other types of vasomotor headache. This statement contains nothing new or original, but I feel sure from my contacts with physicians and from my studies of the literature that this theory is not given the importance it deserves. No theory of venous stasis or temporary pressure from misplaced spinal fluids could possibly explain the regular progression of cortical symptoms from the occipital visual area to the sensory area, and possibly then often to the speech center with no involvement of the motor area. Never in my experience has the motor area of the brain been involved in any vasomotor outburst, whether spoken of as migraine or as allergic or functional headache. In urticaria, certain areas of the skin are affected, with intervening areas of normal tissue, so it does seem reasonable to think of, though one cannot see, certain similiar areas of local tissue reaction in the brain, meninges, ganglions or nerve sheaths during a vasomotor disturbance in these tissues.

IMPORTANCE OF ASSOCIATED CORTICAL SYMPTOMS IN DIFFERENTIAL DIAGNOSIS

Scintillating scotomas (dancing, zigzag lines or spots before the eyes), hemianopia (loss of vision in one field) and blurring of the entire visual field are typical prodromal symptoms in many patients with

migraine, and certainly repetition periodically of such symptoms with periods of normal visual function must suggest that the pain in the head and other associated symptoms which follow have a vasomotor basis. Some patients, as they grow older, may experience only the visual phenomena, without any headache or other associated symptoms.

Paresthesia (numbness in hand, arm, lips or tongue) commonly appears with the visual symptoms or soon after they have developed. If this numbness appears on the left side, the headache will often be present on the right side, which, of course, suggests the cortical involvement of the sensory area. Such symptoms are usually of short duration and are elicited only by a careful history.

Nausea and vomiting are commonly present and usually are most troublesome when the headache is most severe. These symptoms are much more common in the child and the young adult than in the older patient. In fact, it is almost axiomatic that their severity varies in inverse proportion to the age of the patient. Real gastric or intestinal conditions rarely cause headache of any severity, but many severe gastric and intestinal symptoms follow or are associated with headache of vasomotor origin.

Attacks of real rotation vertigo with pallor, perspiration, nausea and vomiting often appear as prodromal symptoms in an attack of migraine. What is of more importance, however, this symptom complex replaces the entire migraine syndrome in many patients for months or years. Such attacks are typical of Ménière's syndrome except that tinnitus and loss of hearing are not present. These attacks, because of their short duration and lack of after-effects, though they are common, are seldom diagnosed. Rarely does an otolaryngologist see such patients at the time of their attacks, and rarely does the general physician, who does see them, consider the real nature of the disturbance. The diagnosis is usually heart trouble or acute indigestion, because the gastrointestinal symptoms and the appearance of the patient are dramatic, and little may be said concerning the causative vertigo. As a rule the general physician does not need to give much thought to the actual nature of the disturbance or to call the otologist in consultation, because the attacks are of short duration and the patient is up and around as well as ever in a few minutes, an hour or a day. The patient recovers quickly regardless of, and usually in spite of, the treatment advised. It is extremely rare for the disability to last as long as twelve hours, and in many instances the effects may be gone within a few minutes or an hour. I have seen few of these attacks but have heard of a great many while taking histories in the office. In only 1 instance have I seen rotary nystagmus, but in that case it was typical of irritative labyrinthitis during the few seconds it was observed. For over two years vertiginous attacks of short duration

replaced my own migraine syndrome, and I assure the reader that the patient suffering with this condition has reason to be seriously disturbed and anxious to be assured that there is no real pathologic change in the brain or elsewhere. Little has been said in the literature concerning this type of Ménière's syndrome, but I feel sure after interviewing patients with vasomotor disorders for many years that it is more common than any other form of vestibular disturbance. Occasionally, of course, a patient may have chronic progressive deafness and tinnitus coincidentally with a tendency toward vasomotor derangement. In such instances differential diagnosis is a real problem.

Aphasia and amnesia of short duration are fairly common in typical cases of migraine. These symptoms, however, are rarely mentioned voluntarily by the patient because of the secret fear that they indicate a real mental disturbance. Many other patients will not mention these complications in the ordinary history because previously, when they did go over their problems with some physician, they were told almost flippantly that they were "just nervous." Fortunately these symptoms are transient and are present only when the headache or some other associated symptoms are demanding most of the attention.

Symptoms referable to the motor area are mentioned simply to emphasize that apparently they rarely, if ever, appear during attacks of vasomotor origin. I have yet to see a patient with epileptic seizures during or after a vasomotor outburst. Naturally it would be possible for epilepsy and migraine to appear in the same person as a coincidence, but in my experience this association has not occurred.

Ophthalmoplegic migraine has been mentioned in the literature for many, many years and has often been given an important place in the classification of the types of this disease. If this term is used to indicate real involvement of some of the motor nerves to the eye as a part of the symptom complex of migraine, I have yet to observe such a case. In my experience, patients with such muscular involvement have eventually disclosed evidence of real pathologic changes, usually a tumor of the brain. It is my opinion that the term ophthalmoplegic migraine is a misnomer and should be deleted from the literature, except as designating a possible rare anomaly that many have never encountered. Ophthalmic migraine also has been used for years as a term to describe a symptom complex. It probably is a proper term when used simply to designate the type of migrainous attack which has unilateral headache in the region of one eye as the prominent symptom. It might be logical to use this term when one is referring to an attack of migraine which begins routinely with scotomas or some other visual disturbance.

Comment.—The associated symptoms mentioned may play a great part in the differential diagnosis of the probable cause of periodic head-

ache or neuralgia. All of these symptoms may appear in some patients, some of them in other patients and none in many. It is important to emphasize that probably no more than 25 per cent of patients suffering from periodic vasomotor headache have any of these associated symptoms. If, however, one or more of them appear in sequence during many periodic attacks of headache or neuralgia, with intervening periods of good health, the diagnosis is practically made, regardless of, and often in spite of, physical findings or other symptoms which have no bearing on the diagnosis. These physical findings, especially roentgen evidence, may easily confuse the issue because of their incidental presence in a region anatomically closely related to the location of the pain. And pain, we must always remember, is the main point of argument in any debate involving the patient, nature and the physician. No one of the individual symptoms is ever as typical as the periodicity of a certain number of them over long periods of time and the regularity of the progression of these symptoms in a patient whose personal and family history suggests possibilities of allergy or migraine. Certainly in many family histories, hay fever, asthma, urticaria and eczema may be interchangeable with migraine or some type of allergic or vasomotor headache.

Pain in the head, periodic and accompanied by such cortical symptoms as mentioned in various combinations can have no other basis than temporary tissue or fluid changes in the brain, meninges, ganglions or nerve sheaths. Real pathologic changes in the nose, sinuses, brain or other part of the head cannot be responsible for such systematic reproduction of similar explosive phenomena over long periods, with intervening periods of good health.

MIGRAINE IN CHILDREN

Migraine, or some type of vasomotor or allergic headache with associated symptoms, is much more common in children than is generally realized and deserves special mention in this paper. Little attention has been given to the subject in the textbooks on pediatrics or even in the current literature of this specialty.

At the age of 4 or 5, the headache itself is often a minor symptom of the periodic attacks, which are characterized by languor, loss of appetite, fever, abdominal discomfort and vomiting. Elevation of temperature, even to high levels, is common, and it may reach 105 or 106 F. within a few hours after the beginning of the attack and then return to normal by the next day. The gastric disturbance in the young child is most marked, and nothing may be said either by the patient or by the parents concerning the headache in the earlier years. Many children have associated symptoms, such as scotomas, general blurred vision and paresthesia, at the beginning of the attacks, but the existence of such

prodromal symptoms may be elicited only by careful attention to the history. Abdominal distress and vomiting are dramatic and take the center of the stage. The association of these symptoms with fever naturally suggests an infective process to the parents and the general physician. During most of these periodic attacks either appendicitis or food poisoning are considered first as the probable diagnosis. Many children during the attacks also have symptoms referable to the nose and throat because of associated vasomotor rhinitis. Naturally the sinuses are often under suspicion, and in many instances the antrums have been explored and irrigated during each attack. Occasionally, an otolaryngologist is called in consultation by the general physician, partly because of the nasal symptoms but mainly because the high fever, normal leukocyte count and indefinite abdominal symptoms are difficult to classify, especially when identical attacks appear periodically. It is likely that in many instances so-called cyclic vomiting represents the early stages of what later becomes a typical migraine syndrome, with headache becoming a more prominent symptom as the child grows older. It is probable that many appendixes have been and are being removed in the hope of relieving these periodic gastrointestinal upsets in children.

One author has estimated that perhaps 1,000,000 children under 12 years of age in the United States are suffering from migraine. Another article in the literature states that approximately 7 per cent of the persons in this country have migraine some time in their lives and that about 30 per cent of all migraine sufferers manifest symptoms before they are 10 years of age. Another article estimates that 2 per cent of all children show some of the symptoms of the migraine syndrome during the first few years of life. A careful history, again, as mentioned before, is of much more importance than all possible physical findings. This case history will usually elicit evidence of hay fever, asthma, eczema or migraine or possibly all of the conditions in the family tree. Hereditary tendencies are of much more importance in arriving at a probable diagnosis of the cause of such periodic identical attacks than consideration of all the possibilities of acquired conditions.

SUMMARY

Headache, even when limited to the periodic type in the ambulatory or office patient, is an extensive subject; twenty minutes is a relatively short time in which to cover even the essential points in differential diagnosis. To conserve time and space, statements will now be made in outline form to cover much of the subject matter and act as a prolonged summary.

A history carefully elicited in relation to the patient and his ancestors is of more value in differential diagnosis of the probable cause of

periodic headache and associated symptoms than any and all types of physical examination.

Headache due to acute nasal obstruction or sinal disease should not and usually does not present any real problems in differential diagnosis. The pain in the head or face secondary to acute inflammation or infection of antrums or frontal or anterior ethmoid sinuses follows almost always in the wake of fairly typical symptoms of acute rhinitis of infectious origin. The pain or headache of acute involvement of the sphenoid sinus may cause confusion in differential diagnosis because of the possible lack of these premonitory nasal symptoms, but history, roentgen evidence and blood counts are fairly typical and dependable in this instance.

Headache secondary to chronic pathologic changes in the nose or sinuses rarely offers real diagnostic difficulties. Patients suffering with these chronic conditions do not commonly seek the advice of the otolaryngologist for relief of headache except during acute exacerbation of the nasal symptoms. They do, however, more commonly go to him for advice because of difficulty in nasal breathing, postnasal discharge, symptoms referable to the throat, chronic bronchitis or asthma.

Pathologic changes in the nose and sinuses are frequently found and easily visualized, especially in the roentgenograms. Vasomotor changes in the brain, meninges, ganglions and nerve sheaths are transient and are never seen. Therefore, it is only reasonable that what is most evident must in many cases seem most explainable. "Seeing is believing" is an old and worn platitude, but it often carries great weight, unfortunately, in the monotonous routine of daily office practice.

Classifications of headache and neuralgia as they appear in the literature are confusing and impractical for the practitioner who hopes to apply what he reads to what he does. Pain is a general symptom; anatomic distribution of nerve fibers and blood vessels can be demonstrated in the cadaver as a local fact, but the probable cause of the pain in any region may be as general in nature as the symptom itself.

In many instances, if the victims of chronic nasal obstruction or sinal disease come for examination with a complaint of periodic headache or facial pain, it is naturally easy to associate these symptoms with physical and roentgen evidence of sinal infection, when a careful history may clearly indicate that the pain is more likely to be of vasomotor origin. Such patients are commonly the victims of coincidence and often pay dearly for these accidental associations. The belief that they are victims of "sinus" (whatever that may be) has probably frequently been confirmed and strengthened over the years by innumerable treatments of, or operations on, the nasal and sinal structures. Reluctantly, I emphasize again what I have been saying for years; otolaryngologists

must rightfully assume much of the blame for the present complex regarding sinal operations in the minds of the laity. Sufferers from migraine or allergy have been willing victims of all kinds of treatments and surgical procedures for years, mainly because they are usually intelligent people trying to rid themselves of a condition which causes marked disability periodically and interferes with their work and pleasure. They are willing and anxious to grasp any likely straw.

For many years, patients suffering from periodic headache and associated symptoms have had seriously impressed on them by the general practitioner, internist and surgeon, after many roentgen examinations and laboratory studies and often a short inquiry into the history, "Physically you are all right; your examination gives entirely negative results. As for your headache, it must be your eyes," or "it must be your sinuses." Actually, it might be more scientific, if not professional, for them to say to many of these patients; "It must be your ancestors."

Sphenopalatine and vidian neuralgia, probably secondary to involvement of the sphenoid sinus, may be clinical entities, but in my own limited experience in everyday office practice, they are almost mythical conditions, except as the syndromes commonly represent transient vasomotor upsets or are associated with a tender mandibular joint and poor dental occlusion. Many harmless sphenoid and posterior ethmoid sinuses have undoubtedly been mutilated because good anatomic work in the dissecting room has innocently led to poor clinical deductions.

Vacuum sinusitis, especially of the frontal sinuses, has been described frequently and has been given a prominent place in otolaryngologic literature by some good workers. According to the principles of physics and physiology, I am told on good authority, such a condition cannot be explained and probably does not exist. I have, however, encountered the symptom complex many, many times in patients whose personal or family history indicated without much doubt that the periodic pains had a vasomotor origin in the brain or meninges rather than in a vacuum in a sinus. Naturally removal of a septal obstruction or portion of a turbinate may give relief of pain for varying lengths of time, but probably it represents only one form of shock therapy in which operative insult to tissues is combined with psychic persuasion.

Pressure pain and headache supposedly due to deflected septums, enlarged turbinates or polyps also have been given a definite clinical place in the otolaryngologic field. Practically, in everyday experience, badly obstructed noses, with pressure from a deflected septum, a spur against the turbinates or large masses of polyps, are common, but often a history of pain or headache cannot be elicited.

Most of the patients who go through their daily business or social life complaining periodically of "sinus headache" are really suffering

from transient vasomotor disturbances within the brain substance or meninges instead of from pressure or infection within the sinuses. Treatment of the nasal membranes with astringents will give temporary relief to many patients with periodic headache as the main symptom, because the close anatomic vascular relation between the brain and the sinal structures allows vasomotor disturbances to be interchangeable. Most of the venous blood from the upper portion of the nose goes through the cribriform plate and then along the floor of the skull to the cavernous sinus. If such patients really had sinal infection, they could not recover periodically from every attack in a day or two through many years with no sequela or other evidence of infection.

Surgery of the nasal and sinal structures has improved rapidly and surely to a high position beside the surgery of the other specialties, but it must be admitted that it now stands much discredited in the minds of most patients and many general physicians. Differential diagnosis has been at fault and not the surgical procedures. Conservative treatment, so called, in the presence of real pathologic changes in the nose or sinuses is often more radical than proper surgical intervention. Most of the arguments against nasal and sinal operation have come, I think, because of the ill advised attempts to relieve or cure symptoms which the history clearly indicated were vasomotor or allergic in origin. All operations and many forms of treatment may act as "shock therapy" and give temporary relief from periodic attacks of any type of vasomotor disturbance, whether that disturbance is migraine, hay fever, or asthma or some other syndrome with a hereditary basis.

Spontaneous relief, temporary or permanent, of periodic headache or neuralgia with associated symptoms of vasomotor or allergic origin is more common than is similar relief from the combination of all treatments and operations in the otolaryngologic field and all other branches of medical practice. Inherited characteristics cannot be suddenly altered by measures which are successful in relieving acquired conditions. In the voluminous literature, medical writers have stressed the hopelessness of efforts to do anything for color blindness, hemophilia or congenital ocular diseases, but they have confidently and valiantly proposed or advised new treatments and operations to relieve or cure hereditary headache and its associated symptoms. Naturally, if one does not follow carefully a large number of patients for long periods of time, one may credit some treatment or operation with the relief that came as a spontaneous change. It is best to remember that patients with periodic pain in the head of the familial type usually have good health between attacks and usually live a full span of life. They then have ample time and opportunity to go from pillar to post, from physician to surgeon and from surgeon to quack.

Actually, those in the medical profession, regardless of the developments of various special fields of practice, have done little to relieve or cure patients with migraine or familial headaches. They have, however, in many instances done much to make them more uncomfortable. Many unfortunates lose their migraine spontaneously but retain distressing nasal symptoms the rest of their lives which are a direct result of ill advised operation on the septum, turbinates or sinuses. Lest otolaryngologists become too conscience stricken, it seems appropriate to mention that many appendixes, gallbladders and pelvic organs would still be functioning in their original surroundings but for other ill advised efforts to alter hereditary conditions by procedures which ordinarily give excellent results when used to remedy acquired difficulties.

All these years otolaryngologists, in their meetings and in the literature, have been told many things to do and how to do them, especially in relation to operation on the nose and sinuses. Much of this advice as to operation, even that given by some great authorities, would have been better left unsaid. In my humble opinion, it behooves more speakers and writers to stress now and then what often should not be done.

Patients suffering from migraine or some other form of hereditary vasomotor pain in the head and associated symptoms should often have nasal obstructions removed, sinuses drained, glasses prescribed, appendixes and gallbladders removed and various treatments given, but only when there are good and sufficient reasons for doing these things regardless of the vasomotor or allergic syndrome and not because of it.

CONCLUSION

Migraine and similar familial, allergic or vasomotor disturbances of the brain, meninges, ganglions, nerve sheaths and other bodily structures are common and probably will continue to be so as long as hereditary characteristics are perpetuated by intermarriage without thought to eugenic selection. Reduction in the numbers and severity of the symptoms and in the numbers of prospective victims is probably more a social than a medical problem. It is to be hoped that in the special field of allergy or of endocrinology or elsewhere consistent scientific effort will find methods to alleviate the symptoms more consistently over longer periods in a greater percentage of the patients who are predestined by heredity to suffer with these periodic upsets in a brain which is otherwise normal. In the meantime let otolaryngologists admit their limitations in the treatment of headache and neuralgia and reserve their scientific surgical procedures to cope with real pathologic conditions, which are and will always be present in the nose and sinuses.

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IMPORTANCE OF VESTIBULAR FINDINGS FOLLOWING INJURY TO THE HEAD

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In 1928 I was privileged to present a paper before the Philadelphia Laryngological Society under the title "Interesting Cochlear and Vestibular Findings Following Accident."[1] It concerned itself in detail with findings and observations in a single case, and the conclusions drawn were therefore limited. The present paper, dealing with a large and varied series of cases of the same sort, broadens understanding and emphasizes the importance of findings descriptive of a clinical entity more or less generally denied or ignored.

In recent years there has arisen an increasing demand for better and clearer understanding and coordination of symptoms and objective findings in conditions resulting from injury to the head. As man penetrates deeper into the mechanical age, demanding shorter and quicker productive means, tempo quickens, and human physical hazards unquestionably multiply. Injuries of the head become proportionately common. A review of the statistical increase in accidents to the head during the development of the machine age in general and the automobile age in particular is convincing. Injuries of the head vary widely in character, severity and sequelae and become the concern of all physicians, particularly the industrial surgeon and the general practitioner, who make the earlier examinations. Subsequent responsibility rests with the neurologist and neuro-otologist.

From a medicolegal aspect, particularly where workmen's compensation laws apply, accurate consideration of the injured is of vital importance. Not only must proof of disability be established, but its character, extent and ultimate outlook must be evaluated. It is essential and timely, therefore, to add, if possible, further means of excluding unjust claims and awards and, at the same time, protecting claims that are genuine and worthy.

When demonstrable fracture of the skull occurs, the problem of explaining and defining resulting pathologic changes and symptoms is usually simplified, but when the calvarium is injured and no demon-

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Read at a meeting of the Philadelphia Laryngological Society, April 4, 1939.

1. Zacks, M. A.: Interesting Cochlear and Vestibular Findings Following Accident, Laryngoscope **38**:288, 1928.

strable break in its bony continuity exists, the examining physician is frequently confronted with an admittedly perplexing problem. In the vast majority of cases of the latter type, subjective complaints far outweigh objective neurologic disclosures.

Many persons with a history of injury to the head, recent or of long standing, still receive routine examination, and the condition is diagnosed and disposed of as belonging to the post-traumatic group (for instance, neurasthenia, traumatic neurosis, psychoneurosis, hysteria and malingering). Definite organic cause is admitted when findings are fairly clear or self evident, but when neurologic findings are negative or questionable because the pathologic disturbance is obscure or varied in location, many conditions are misjudged as functional. Such diagnoses, though becoming less common, still too frequently appear on completed hospital records as the undisputed final opinion.

In such cases vestibular tests are of great value and, if performed precisely and systematically and properly interpreted, offer valuable diagnostic information. The neuro-otologist has been invited into this field of investigation because symptoms so frequently point to disturbance in the kinetic-static mechanism. Examination of the internal ear is decidedly incomplete if only the function of hearing is determined, since the kinetic-static portion deserves equal consideration. Rotatory and caloric tests give information on the behavior of the vestibular mechanism in much the same fashion as tuning forks and an audiometer enable one to determine the hearing. By familiarity with normal vestibular responses following artificial stimulation, together with an understanding of the anatomy and pathways concerned, deviations from normal are recognized and the seat of disturbance surmised and frequently localized. It should be emphasized that neurologic findings may be negative and the vestibular mechanism, including the pathways of the intracranial nerves, considerably damaged and deranged. For this reason every patient with injury to the head subjectively disturbed, particularly when consciousness has been lost, deserves vestibular investigation. Hearing tests are subjective and depend entirely on the intelligence, honesty and cooperation of the patient, whereas vestibular responses are objective and yield information concerning the internal ear and the vestibular apparatus in the brain over which the patient exercises little or no control. It is on the objective evidence of a deranged kinetic-static mechanism that diagnostic conclusions are made possible.

After the immediate and acute effects of injury to the head have subsided, after-effects begin to make their appearances, and it is with these that this paper is concerned. It is the rule for patients to attribute their symptoms directly to a specific accident.

Children, particularly below the age of 10 years, show little tendency to develop symptoms or sequelae, notwithstanding the severity of the accident or the occurrence of prolonged unconsciousness. One patient, a boy aged 6 years, was unconscious for twenty-one days after an automobile accident and at the time of writing, eleven months after his injury, has not offered any subjective complaints. Vestibular and auditory findings are normal. His brother, aged 11 years, was rendered unconscious for twenty-four hours in the same accident. He experienced two or three attacks of vomiting per week for the next six months. When last examined he complained of headache and dizziness, particularly on change of position, fell when the head was bent downward and staggered at times. It is of interest to note that this patient, five years older, unconscious for twenty-four hours in contrast to the twenty-one days of unconsciousness experienced by the other, presents symptoms and findings indicative of intracranial damage. Another, a boy aged 9, in an attempt to halt a runaway horse, was dragged for almost a city block, when the horse stumbled and fell on him. He was unconscious for an indefinite period. Except for a 14 per cent loss of hearing for the conversational range in the right ear, together with peripheral involvement of the seventh nerve on the same side, he shows no neuro-otologic disturbance. Generally, the older the patient the more evident the disturbed reactions, particularly after the age of 50. Age is one explanation for the disproportion between the severity of injury and the resulting symptomatic damage.

SYMPTOMS

While it is true that conclusions depend on the type and character of vestibular responses, a careful history of all subjective complaints is important. Symptoms vary, are frequently vague and may be changeable. It is impossible to determine their precise order of appearance, and while, as a rule, post-traumatic conditions have many symptoms in common, an attempt to place them in a diagnostic group, while generally informative, proved unconvincing. However, certain subjective complaints deserve special mention:

Headache.—This is the most frequent subjective symptom and, like the next, vertigo, varies generously. Occipital pains are common.

Vertigo.—This complaint rivals the first mentioned in variation and frequency and is commonly in combination with it. It is variously described, as, for instance, "falling to one side," "things moving before the eyes," "tremors," "a feeling of goneness," "unsteadiness," "pounding" or "a feeling of drunkenness." Vertigo in the sense that objects definitely revolve in fixed fashion is exceptional and when artificially induced bears little, if any, resemblance to the type of which the patient

complains. This fact deserves emphasis. Vertigo may be originated or intensified by change of position, such as from the stooping to the upright, quick motion of the head and lifting of heavy objects. When damage to the labyrinth is mild, attacks come on irregularly and may not appear until some time after the injury. Vertigo, when frequent, persistent and easily induced, is a most unfortunate symptom and, according to some, deserves greater financial compensation than complete loss of hearing in one ear. Vertigo which persists more or less unchanged for six to eight months offers a guarded prognosis; after twelve to fifteen months the outlook is discouraging and grave.

Fatigue and Weakness.—Undue fatigue on slight or moderate physical effort is common. Many patients maintain that they are tired all the time. Insomnia is common. This may be interpreted as an expression of a diseased brain. Vasomotor instability is commonly observed.

Changes in Mentality and Personality.—Attention is called to these by members of the patient's family, friends and the family physician, who state that something has come over the patient since his accident. Common complaints are lack of interest in conditions that previously engaged serious attention, inability to concentrate, faulty memory, shrinking interest in dress and personal habits, fear of crowds and general disinclination to return to the previous normal standard. Efficiency usually suffers, often so as to demand changes of occupation. It is not unreasonable to assume that the above symptoms, together with those mentioned in the previous paragraph, may have a common explanation.

Defects in Hearing.—The complaint of disturbed hearing, particularly in one ear, is common. Tuning forks and an audiometer aid in the determination of type, location and extent of deafness. Unilateral perceptive involvement is by far the most common. When findings indicate disturbance in the conductive mechanism, improvement under treatment may follow, but when there is a loss of perception for notes in the upper part of the scale, the basal coil of the cochlea has been damaged, and little, if any, tendency to spontaneous recovery should be expected. While tuning forks are of value so far as the Weber, Rinne and Schwabach tests are concerned, the audiometer offers valuable information, since it is not uncommon that forks and the Galton whistle are heard well but when the hearing is checked with the audiometer, dips in the high register are noted.

PATHOLOGIC CHANGES

In order to interpret symptoms and findings a conception of the underlying pathologic changes is necessary. Because of the numerous

and various forms of trauma, the resulting pathologic changes and sequelae differ in type, degree and location. However, they possess much in common, and it is by the interpretation of this that a basis for conclusions is afforded. Injury to the labyrinth may be caused by an exudate into it. A more violent trauma may tear portions of the auditory and vestibular end organs. Sudden displacement of the brain stem by the impact may directly injure the eighth nerve as it enters the fallopian canal. Considerable research and experimental study of the pathologic changes resulting from injuries to the head were undertaken by Brunner,[2] Yoshii,[3] Stenger[4] and others. Their findings are reported at length in the literature. It was Brunner's conviction that as a result of injuries to the head in the human being degenerative changes occur in the nuclei of the cochlear and vestibular nerves. He showed also that the altered irritability of the vasodilators and vasoconstrictors causes localized areas of altered circulation. Traumatic paralysis of the vasoconstrictors is probably due to damage of the midbrain. Long-continued vasomotor changes produce cellular abnormalities which may finally terminate in areas of necrosis and formation of scar tissue. Direct damage may occur to the eighth nerve or the labyrinth itself, particularly when the petrous portion of the temporal bone is fractured. This aspect, however, is deliberately omitted. Experimental evidence emphasizes that the damage is not localized to the ear itself but that in every case of symptomatic injury to the head the brain, too, is injured. Brunner asserted that one can have concussion of the brain without concussion of the inner ear but cannot have concussion of the inner ear without concussion of the brain. In 1928 I[1] emphasized that findings indicated a combination of central and peripheral involvement. This is in accord with subsequent findings recorded by Linthicum and Rand,[5] whose experiences indicated that in nearly all instances the vestibular symptoms following concussion are due to the combination of injury to the end organ and to the central nervous system. Experimentally, in animals, it has been shown that little relation exists between the severity of impact and the amount of damage resulting.

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2. Brunner, H.: Pathologie und Klinik der Erkrankungen des Innenohres nach Stumpfen Schädeltraumen, Monatschr. f. Ohrenh. **59**:697, 1925.

3. Yoshii, U.: Experimental Study of Traumatic Injuries of the Ear, Zentralbl. f. Ohrenh. **9**:561, 1910-1911.

4. Stenger: Ueber die Arten der nach Kopfverletzungen auftretenden Neurosen: Die traumatische Labyrinthneurose, Deutsche med. Wchnschr. **31**:63, 1905.

5. Linthicum, F. H., and Rand, C. W.: Neuro-Otological Observations in Concussion of the Brain, Arch. Otolaryng. **13**:785 (June) 1931.

DIAGNOSTIC DATA

An attempt was made at tabulation based on symptoms and findings in individual cases, but the data were found lengthy, complicated and confusing and served a relatively limited purpose. Instead, emphasis is placed on the most common and significant deviation offering diagnostic leads.

Examination depends on reactions that are (1) spontaneous or (2) artificially induced.

1. *Spontaneous Reactions.*—(*a*) If nystagmus is present, its type and character are noted. Unless the patient is observed early, it is usually absent. If the labyrinth has been destroyed spontaneous nystagmus toward the sound side is noted immediately after the injury. It is amplified when the patient looks toward the healthy side. Intense vertigo and nausea are present, particularly when movements of the head occur. I have never encountered spontaneous vertical nystagmus either upward or downward resulting from injury to the head. An occasional upward twitch may be noted but should not be confounded with true nystagmus. It is questionable whether the direction of the nystagmus furnishes trustworthy information regarding the injured side. I am inclined to agree with Grove,[6] who stated that the nystagmus is caused by a decompensation or imbalance between the two labyrinths.

(*b*) Past pointing is common, important and usually confined to pointing with one hand and may be inward or outward.

(*c*) The Romberg test and the pelvic girdle test show whether swaying or falling is present. Swaying is commonly observed after injury to the head. The direction in which the patient falls when the head is turned quickly to either side with the eyes closed is noted. Falling may give some inkling as to whether one is dealing with a central or a peripheral lesion. The sooner after the accident the test is applied, the greater its value.

2. *Artificially Induced Reactions.*—These are brought about by (*a*) rotation in a revolving chair or (*b*) caloric stimulation (cold or warm solutions). It is on this portion of the test that greatest reliance is placed, particularly on the reaction to caloric stimulation. A fairly wide variety of abnormal responses is observed. Such responses may vary from time to time in the same patient, particularly in degree, but unless spontaneous recovery occurs within six to twelve months, the type of abnormal response persists, and even further degenerative change is apt to appear. The vertical canals or the horizontal canal may show delayed and impaired response after injury and when reexamined at a later time may show further impairment or complete loss of function.

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6. Grove, W. E.: Otologic Observations in Trauma of the Head: Clinical Study Based on Forty-Two Cases, Arch. Otolaryng. **8**:249 (Sept.) 1928.

(*a*) Rotation in a Revolving Chair: If examination is made soon after the accident, a discrepancy between the after-turning nystagmus and vertigo on one or both sides may be noted. Later on responses may be normal, hypoactive or hyperactive and furnish relatively little valuable lasting information. However, it is interesting to observe the striking difference in response from the horizontal canals when reactions to turning are compared with those to caloric stimulation. The examiner is inclined to question whether the same mechanism is stimulated, since it is not uncommon to observe fairly good or normal postrotational horizontal nystagmus and impairment or absence of nystagmus following caloric stimulation.

Past pointing may be present with one or both arms, normal with one and crossed with the other. Perverted past pointing should be regarded as significant. Nystagmus may be good, even hyperactive in amplitude and duration after stimulation and past pointing absent.

As previously mentioned, the type of spontaneous vertigo resembles little if at all that which is experienced after rotation. Shortened postrotational vertigo is common.

(*b*) Caloric Stimulation: Examples of a few of the most common findings are reviewed (roentgen evidence negative for fracture of the skull; results of neurologic examination negative for organic pathologic change):

Normal responses from all canals on one side with absence of responses from all canals on the opposite side.

Case of C. L.—A man aged 51 fell down stairs in April 1937, striking the back of the head. He was unconscious for two or three hours and was removed to a hospital, where he remained four or five days. The chief complaints were headache, dizzy spells (falling to the left, particularly on stooping and other change of position), impaired hearing in the left ear, easily induced fatigue, changes in personality ("wants to be left alone and not bothered") and inability to sleep unless sitting up in a chair. Vestibular examination was performed twenty months after the accident.

Spontaneous Reactions.—Nystagmus was absent when the patient was looking straight ahead, to the extreme right or left, upward or downward. The Romberg test showed slight swaying. When the patient was standing with the heels and toes approximated and the eyes closed there was a tendency to fall toward the left when the head was suddenly turned to the right and then to the left. Movements of the pelvic girdle were fair. Past pointing was absent with each arm.

Artificially Induced Reactions.—Turning Test: On turning to the right, ten turns in twenty seconds, the patient exhibited horizontal nystagmus to the left of poor amplitude and ten seconds' duration and vertigo of thirteen seconds' duration. Past pointing occurred, 4 inches (10 cm.) to the right, with the right arm and was absent with the left. On turning to the left, the patient exhibited horizontal nystagmus to the right of fair amplitude and twelve seconds' duration and vertigo of seven seconds' duration. Past pointing was absent with each arm.

Caloric Test (68 F.): After fifty seconds' stimulation of the right ear, with the head erect, rotary nystagmus to the left was observed with good amplitude.

Past pointing occurred, 4 inches (10 cm.) to the right with each arm. When the head was tilted back horizontal nystagmus to the left was observed with good amplitude. With the head in this position past pointing occurred, 4 inches (10 cm.) to the right with each arm. When the left ear was similarly tested a response was not observed from the vertical canals or the horizontal canal after four minutes of stimulation. Past pointing was absent with each arm.

Conversational hearing was tested separately in each ear when the ears were separately irrigated during the caloric test and found good on both sides. Since the patient was not affected by the tests, they were all performed at a single sitting.

Neurologic Report.—"There seems to be little in the way of objective symptoms. Signs of a cerebellar defect are not present. The condition resembles post-traumatic neurosis. Further observation is necessary."

Notwithstanding the absence of responses to caloric stimulation on the left side, conversational hearing is good in that ear.

Normal responses from all canals on one side with delay and impairment of responses from the vertical canals and absence of response from the horizontal canal on the opposite side.

Case of G. M.—A man aged 37, an iron worker, in June 1937, while at work, was suddeny raised in the air by a cable to an unknown height and on releasing himself fell on his head. He was unconscious the first four days during his hospitalization of twenty-five days. The chief complaints were vertigo, particularly on turning the head and stooping, impairment of hearing in the left ear, constant noises in the left ear, changes in personality, a feeling of limpness and occasional staggering to either side necessitating "holding on to something to support himself." Vestibular examination was performed nineteen months after the accident.

Spontaneous Reactions.—Nystagmus was absent except for a few twitches on looking upward. The Romberg test showed swaying. On turning the head first to the right and then to the left, swaying occurred. Movements of the pelvic girdle were fairly good. Past pointing was absent with each arm. Unsteadiness was noted in each arm.

Artificially Induced Reactions.—Turning Test: On turning to the right, the patient had horizontal nystagmus to the left of fair amplitude and eight seconds' duration and vertigo of twenty-four seconds' duration. Past pointing was absent with each arm. On turning to the left, the patient exhibited horizontal nystagmus to the right of good amplitude and seventeen seconds' duration and vertigo of twenty-six seconds' duration. Past pointing was absent with each arm.

Caloric Test: After fifty seconds' stimulation of the right ear, wtih the head erect, a rotary nystagmus to the left was observed with fair amplitude. Past pointing occurred, 2 inches (5 cm.) to the right, with the right arm but was absent with the left. When the head was tilted back horizontal nystagmus to the left was observed, with large amplitude. With the head in this position past pointing occurred, 2 inches (5 cm.) to the right, with the right arm but was absent with the left. When the left ear was similarly tested rotary nystagmus to the right appeared after one minute and five seconds, with poor amplitude. Past pointing was absent with each arm. When the head was tilted back there was no response from the left horizontal canal. Past pointing was absent with each arm.

Conversational hearing was found impaired in the left ear and good in the right. Since the patient was not affected by the tests they were all performed at a single sitting.

The audiogram showed a sharp dip in the threshold of the left ear from 512 double vibrations (15 decibels) to 1024 (50 decibels) and 2048 (65 decibels).

Absence of responses from all canals on one side with absence of responses from the vertical canals on the opposite side and a normal or subnormal response from the horizontal canal (a syndrome similar to that with tumor of the cerebellopontile angle). I [1] called attention to this finding in 1928 in a report before the Philadelphia Laryngological Society. It has been repeatedly observed and mentioned in the literature since and may perhaps be considered, when present, the most significant syndrome symptomatic of post-traumatic cerebral damage. Linthicum and Rand [5] mentioned my reported case and reported 6 such cases of their own. The differentiation of the condition from tumor of the angle is not difficult, since tumor of the angle has a delayed onset with tinnitus, hearing and vestibular responses are either impaired or absent on the side of involvement and the opposite vertical canals are nonresponsive, while the horizontal canal is active and commonly exhibits an active, perverted response. If added to this vertical nystagmus, papilledema, or choked disk, peripheral involvement of the seventh nerve and absence of corneal reflex on the same side are present, the diagnosis of tumor of the angle is definite.

Case of W. C.—A man aged 32, a carpenter, in June 1925, while riding in his automobile, was struck by a trolley car. He was rendered unconscious and removed to a hospital. He remained unconscious for three days, during which he vomited frequently. He was hospitalized for eighteen days. On regaining consciousness he complained of total loss of hearing, vertigo and staggering. Vestibular examination was performed six months after the accident.

Spontaneous Reactions.—On the patient's looking to the right there was horizontal nystagmus to the right; on his looking to the left there was horizontal nystagmus to the left; on his looking upward or downward nystagmus was absent. The Romberg test was negative. Turning the head first to the right and then to the left did not produce any effect. Movements of the pelvic girdle were good. Past pointing was absent with each arm.

Artificially Induced Reactions.—Turning Test: On turning to the right the patient exhibited horizontal nystagmus to the left of fair amplitude, eleven seconds' duration and vertigo of thirteen seconds' duration. Past pointing occurred, 3 inches (8 cm.) to the right with the right arm and 2 inches (5 cm.) to the right with the left arm. On turning to the left the patient exhibited horizontal nystagmus to the right of fair amplitude and eleven seconds' duration and vertigo of ten seconds' duration. Past pointing occurred, 4 inches (10 cm.) to the left, with the right arm but was absent with the left arm.

Caloric Test: After four minutes' stimulation of the right ear, with the head erect, the right vertical canals did not show any response. Past pointing was absent with each arm. When the head was tilted back there was no response from the right horizontal canal. Past pointing was absent with each arm. When the left ear was similarly tested the left vertical canals showed no response after four minutes. Past pointing was absent with each arm. When the head was

tilted back horizontal nystagmus to the right was observed with fair amplitude. Past pointing occurred, 4 inches (10 cm.) to the left with each arm.

Conversational hearing was absent in both ears. Since the patient was not affected by the tests, they were all performed at a single sitting.

Audiogram.—The right ear was totally deaf to all sounds from C (64 double vibrations) to c-6 (8192 double vibrations). Observations on the left ear were identical with those on the right except that with the dial at approximately 85, c-2 (512 double vibrations) was definitely and unmistakably heard. This represents a 68 per cent loss of hearing for this single remnant.

Eight patients in the series presented this syndrome. Hearing may be impaired or absent on one or both sides. The single canal to react is the horizontal, from which the nystagmus may be good, fair or poor and either horizontal or perverted.

Absence of responses from the vertical canals on each side and a perverted response from the horizontal canal on each side, with acute hearing in both ears for the conversational range. Beyond this frequency, particularly in the upper limits, dips are common.

CASE OF J. J.—A man aged 27, a steel worker, fell from a six story height down an elevator shaft, October 1936. He stated that he was unconscious for two or three minutes. He was hospitalized for eight days. His chief complaints were severe headaches, dizziness, particularly on stooping, insomnia, loss of weight and fatigability. Vestibular examination was performed two years after the accident.

Spontaneous Reactions.—Nystagmus was absent. The Romberg test was negative. Turning the head first to the right and then to the left did not produce any effect. Movements of the pelvic girdle were good. Past pointing occurred, 6 inches (15 cm.) to the right, with the right arm but was absent with the left.

Artificially Induced Reactions.—Turning Test: On turning to the right the patient exhibited horizontal nystagmus to the left of good amplitude and twenty-six seconds' duration and vertigo of twenty-eight seconds' duration. Past pointing occurred, 10 inches (25 cm.) to the right, with the right arm but was absent with the left. On turning to the left the patient exhibited horizontal nystagmus to the right of good amplitude and twenty-six seconds' duration and vertigo of twenty-six seconds' duration. Past pointing occurred, 6 inches (15 cm.) to the left with each arm.

Caloric Test: After four minutes' stimulation of the right ear, with the head erect, the right vertical canals showed no response. Past pointing occurred 4 inches (10 cm.) to the left, with the right arm but was absent with the left. When the head was tilted back perverted (oblique) nystagmus to the left was observed with fair amplitude. Past pointing was absent with each arm. When the left ear was similarly tested the left vertical canals showed no response after four minutes. Past pointing was absent with each arm. When the head was tilted back perverted (oblique) nystagmus to the right was observed, with poor amplitude. Past pointing was absent with each arm.

Conversational hearing was acute in both ears. All tests were performed at a single setting, although the patient felt drunk and was slightly nauseated (?).

Conversational hearing was acute in both ears. When tested with the audiometer, the hearing was noted to be good throughout the

entire scale. It is interesting to note that the response from the vertical canals on each side was absent, while that from the horizontal canal on each side was perverted.

Absence of response from the vertical canals on each side and a perverted response from the horizontal canal on each side, with impaired hearing in both ears.

CASE OF J. R.—A man aged 60 tripped over an iron pipe in September 1938, striking the head against a sidewalk. An indefinite short loss of consciousness followed. He was removed to a hospital but refused to remain for treatment beyond emergency measures. His chief complaints were impairment of hearing in both ears (he stated that prior to the accident he could hear a clock ticking in the next room), headache, vertigo and confusion. Vestibular examination was performed three months after the accident.

Spontaneous Reactions.—Nystagmus was absent. The Romberg test was negative. Turning the head first to the right and then to the left did not produce any effect. Movements of the pelvic girdle were good. Past pointing was absent with the right arm but occurred, 4 inches (10 cm.) to the left, with the left arm.

Artificially Induced Reactions.—Turning Test: On turning to the right the patient exhibited horizontal nystagmus to the left of good amplitude and seventeen seconds' duration and vertigo of twelve seconds' duration. Past pointing occurred, 8 inches (20 cm.) to the right, with the right arm but was absent with the left. On turning to the left the patient exhibited horizontal nystagmus to the right of fair amplitude and sixteen seconds' duration and vertigo of twelve seconds' duration. Past pointing was absent with the right arm but occurred, 8 inches (20 cm.) to the left, with the left arm.

Caloric Test: After four minutes' stimulation of the right ear, with the head erect, the right vertical canals showed no response. Past pointing was absent with each arm. When the head was tilted back perverted (oblique) nystagmus to the left was observed with fair amplitude. Past pointing was absent with each arm. When the left ear was similarly tested the left vertical canals showed no response after four minutes. Past pointing was absent with each arm. When the head was tilted back perverted (oblique) nystagmus to the right was observed, with fair amplitude. Past pointing was absent with each arm.

Conversational hearing was impaired in both ears. Since the patient was not affected by the tests, they were all performed at a single sitting.

Caloric responses were more or less identical with those in the case of J. J. except for the bilateral impairment of hearing of the perceptive type. There was a sharp dip in the audiogram in both ears beyond the frequency 2896.

Absence of response from the vertical canals on one side with a perverted response from the horizontal canal on the opposite side.

CASE OF J. H.—A youth aged 18, a sheet metal worker, was rendered unconscious for an unknown period in October 1938, when a trolley car jammed into the automobile in which he was riding. He was taken to a hospital and according to his own statement was dazed for several hours immediately after the accident. He remained in the hospital for eight days. His chief complaints were "thumping on the top of the head," headaches, dizziness, changes in personality, deafness in

the left ear and the loss of 21 pounds (9.5 Kg.) in the three months after the accident. He stated that his hearing was perfect prior to the accident and that none of the foregoing symptoms was ever present. Vestibular examination was performed five months after the accident.

Spontaneous Reactions.—Nystagmus was absent. The Romberg test was negative. Turning the head first to the right and then to the left did not produce an effect. Movements of the pelvic girdle were good. Past pointing was absent with each arm.

Artificially Induced Reactions.—Turning Test: On turning to the right the patient exhibited horizontal nystagmus to the left of small amplitude and two seconds' duration and vertigo of nine seconds' duration. Past pointing occurred, 4 inches (10 cm.) to the left, with the right arm but was absent with the left. On turning to the left the patient exhibited horizontal nystagmus to the right of poor amplitude and six seconds' duration and vertigo of fifteen seconds' duration. Past pointing occurred, 2 inches (3 cm.) to the left, with the right arm but was absent with the left.

Caloric Test: After four minutes' stimulation of the right ear, with the head erect, the right vertical canals showed no response. Past pointing was absent with each arm. When the head was tilted back horizontal nystagmus to the left was observed, of poor amplitude. Past pointing was absent with each arm. When the left ear was similarly tested the left vertical canals produced a rotary response to the right after one minute and fifteen seconds, with fair amplitude. Past pointing was absent with the right arm but occurred, 4 inches (10 cm.) to the right, with the left arm. When the head was tilted back rotary (perverted) nystagmus to the right was observed, with good amplitude. Past pointing was absent with each arm.

Conversational hearing was found absent in the left ear but acute in the right ear. Since the patient was not affected by the tests they were all performed at a single sitting.

Audiogram.—The left ear showed 51 per cent loss of hearing; the right ear did not show any loss of hearing for the conversational range.

Caloric stimulation on the right side was followed by no response in the right vertical canals with a poor response in the right horizontal canal, notwithstanding acute hearing in that ear. On the left side the vertical canals were hypoactive, while the left horizontal canal showed good but perverted (rotary) response. Conversational hearing was absent on that side.

Absence of response from the vertical canals on one side and a perverted response from the horizontal canal on the same side, with good conversational hearing on this side.

Case of W. M.—A man aged 25, a cabinet maker, in January 1931, while driving his automobile, was struck by a trolley car and rendered unconscious for several hours. When consciousness was regained he was in a hospital. A bloody discharge from the left ear was present for several days. His chief complaints were headaches, vertigo, confusion, tinnitus and impaired hearing in the left ear. Vestibular examination was performed thirteen months after the accident.

Spontaneous Reactions.—Nystagmus was absent except for a few twitches on looking upward. The Romberg test was negative. Turning the head first to the

right and then to the left did not produce any effect. Movements of the pelvic girdle were absent. Past pointing was absent with each arm.

Artificially Induced Reactions.—Turning Test: On turning to the right the patient exhibited horizontal nystagmus to the left of good amplitude and twenty-four seconds' duration and vertigo of ten seconds' duration. Past pointing occurred, 4 inches (10 cm.) to the right with each arm. On turning to the left the patient exhibited horizontal nystagmus to the right of good amplitude and twenty seconds' duration and vertigo of fifteen seconds' duration. Past pointing occurred, 4 inches (10 cm.) to the left with each arm.

Caloric Test: After three minutes' stimulation of the right ear, with the head erect, the right vertical canals showed no response. Past pointing was absent with each arm. When the head was tilted back perverted (oblique) nystagmus to the left was observed, rapid, with small amplitude. Past pointing occurred, 6 inches (15 cm.) to the right with the right arm and 6 inches (15 cm.) to the left with the left arm. When the left ear was similarly tested the left vertical canals produced rotary nystagmus to the right after two minutes, with small amplitude. Past pointing was absent with the right arm but occurred, 6 inches (15 cm.) to the left, with the left arm. When the head was tilted back, rotary (perverted) nystagmus to the right was observed, rapid, with small amplitude. Past pointing was absent with the right arm but occurred, 6 inches (15 cm.) to the left, with the left arm.

Conversational hearing was absent in the left ear and acute in the right ear. Although the patient showed a slight tendency to perspire and was slightly nauseated, all the tests were performed at a single sitting.

There was a perverted response from the horizontal canal on each side. On the side of acute conversational hearing, the response from the vertical canals was absent, while the response from the horizontal canal was perverted (oblique). On the nonhearing (conversational) side, the vertical canals responded poorly, while there was a rotary (perverted) response from the horizontal canal.

Conversational hearing may be acute, impaired or absent on the same side as, or the side opposite to, abnormal responses from the semicircular canals. Changes in the upper frequency range are common.

The foregoing illustrations are representative of a few combinations of disturbed reactions. The examiner is impressed by the inconstancy of findings and the variety of combinations that may follow symptomatic injury to the head.

ADDITIONAL OBSERVATIONS

Injury to the Cranial Nerves.—Except for disturbed function observed in the cochlear and the vestibular portion of the eighth nerve, the cranial nerves are rarely involved unless the condition is complicated by fracture of the skull.

Constitutional Reactions.—When the ears of a normal person are douched with cold water (68 F.) for forty to sixty seconds, evidences of susceptibility to vestibular stimulation appear, as pallor, perspiration, nausea and, at times, vomiting. The absence of sensitivity after pro-

longed douching, particularly when active nystagmus has been induced, offers valuable evidence in favor of intracranial involvement. As a rule, diminution or absence of susceptibility to tests is noted in cases of symptomatic injury to the head.

CONCLUSIONS

Every patient with injury to the head subjectively disturbed should be examined neuro-otologically as soon after injury as possible and reexamined occasionally for approximately one year to determine the integrity of the kinetic-static and the auditory mechanism.

While a definite objective syndrome is not produced, vestibular tests are of inestimable value in offering a possible explanation for subjective symptomatic complaints.

Headaches and disturbances of equilibrium following injury to the head, if persistent, show derangement of the kinetic-static mechanism.

Concussion of the inner ear and brain result from the same force, producing evidences of combined central and peripheral involvement, the extent of which is not always in direct proportion to the force or type of trauma.

Vestibular abnormalities offer an organic explanation for many so-called functional disturbances.

Findings similar to those with tumor of the cerebellopontile angle, when present, are significant. They occur in a fairly large percentage of cases.

Persons suffering from symptomatic post-traumatic conditions of the head deserve financial compensation commensurate with their physical handicap.

A plea is made for closer cooperation between the family physician, the industrial surgeon, the neurologist and the neuro-otologist.

Findings, symptoms and sequelae help to clarify a clinical condition far too important to neglect or ignore.

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CARCINOMA OF THE TRACHEA

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In recent years, several discussions of primary carcinoma of the trachea have appeared in the literature. Notable among these are the reviews of Culp,[1] Leroux-Robert,[2] Baratoux,[3] Tiling,[4] Dumas and Guichard [5] and D'Aunoy and Zoeller.[6] With the exception of Baratoux, these reviewers have dealt primarily with the morphologic character of the tumor, and the clinical and therapeutic aspects have been touched on only briefly or have been ignored. In the great majority of the cases reported the diagnosis was established at necropsy. This is particularly true of the earlier cases. Hence, it is not surprising that most of the reports consist primarily of pathologic data. Since bronchoscopic examination has come to be recognized as a valuable diagnostic procedure, discovery of primary intratracheal neoplasms during the life of the patient is no longer uncommon.

It is the purpose of this discussion to attempt to correlate the pathologic findings with the symptoms and treatment in cases of carcinoma of the trachea. Sixteen cases of primary carcinoma of the trachea encountered at the Mayo Clinic since 1921 will be reviewed. Of these 16 cases 5 have been previously reported by Figi,[7] 1 by Guttman [8] and

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Abridgment of a thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfilment of the requirements for the degree of Master of Science in Medicine.

1. Culp, O. S.: Primary Carcinoma of the Trachea, J. Thoracic Surg. **7**:471-487, 1938.

2. Leroux-Robert, J.: Les cancers primitifs de la trachée: Étude anatomo-pathologique (à propos d'un cas d'épithélioma prostradiothérapique de la trachée chez une basedowienne), Ann. d'oto-laryng., May 1936, pp. 493-521.

3. Baratoux, J. E.: Tumeurs malignes primitives de la trachée, Ann. d'oto-laryng., November 1933, pp. 1272-1289.

4. Tiling, W.: Ueber Trachealcarcinome im Anschluss an einem Fall von Basalzellen Carcinom, Monatschr. f. Ohrenh. **67**:322-347 (March) 1933.

5. Dumas, A., and Guichard, A.: Cancer primitif de la trachée, Lyon méd. **148**:642-646 (Nov. 29) 1931.

6. D'Aunoy, R., and Zoeller, A.: Primary Tumors of the Trachea: Report of a Case and Review of the Literature, Arch. Path. **11**:589-600 (April) 1931.

7. Figi, F. A.: Primary Carcinoma of the Trachea, Arch. Otolaryng. **12**: 446-456 (Oct.) 1930.

8. Guttman, M. R.: Primary Adenocystic Carcinoma or Cylindroma of the Trachea, Ann. Otol., Rhin. & Laryng. **45**:894-901 (Sept.) 1936.

1 by Vinson and Leddy.[9] Nine have not been previously reported. Of the 16 cases, the correct diagnosis was made during the life of the patient in 15. In the remaining case, autopsy performed elsewhere disclosed that the patient had been suffering from an annular carcinoma situated just below the vocal cords.

Specimens for biopsy were taken from the 15 patients by surgical or endoscopic means, and this material has been available for microscopic study. Histologically the 15 tumors can be divided into two general classes: first, those which arise from cells normally lining the trachea and which for purposes of clarity will be considered as adenocarcinomas and, second, those which distinctly were squamous cell epitheliomas. Of the specimens obtained from 15 patients, 9 were adenocarcinomas and 6 were squamous cell epitheliomas. The grading system of Broders [10] was used in each case. Grade 1 indicates a low degree of malignancy; grade 4, a high degree.

Differentiation of cells forms the underlying principle on which the carcinomas are graded. Thus, grade 1 signifies a neoplasm in which at least 75 per cent of the cells are differentiated. Grades 2, 3 and 4 have 50 to 75 per cent, 25 to 50 per cent and 0 to 25 per cent respectively of differentiated cells.

HISTOGENESIS

Present day theories of the development of epithelial tumors are based on the conception of the universal basal or germinal cell layer. Applied to the respiratory system, these views are well summarized by Fried.[11] It has long been known (Ribbert [12]) that neoplasms are derived from undifferentiated cells. Hence, the ciliated columnar cells of the tracheobronchial tree are incapable in themselves of producing tumors. It is thought that the basal cells of all epithelial surfaces are undifferentiated and that they are essentially similar throughout the body. They are capable of regenerative power and reproduce cells which are characteristic of the epithelium in which they are situated. When that unknown factor appears which removes the normal restraint on the production of cells, a tumor results, comprised of cells derived from the germinal layer. In a structure such as the trachea or a bronchus, the basal layer gives rise to surface epithelial (ciliated columnar) cells, goblet cells and the serous or mucous cells of the glandular structures in the lamina propria.

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9. Vinson, P. P., and Leddy, E. T.: Cancer of the Trachea, Proc. Staff Meet., Mayo Clin. **8**:641-643 (Oct. 25) 1933.

10. Broders, A. C.: The Grading of Carcinoma, Minnesota Med. **8**:726-730 (Dec.) 1925.

11. Fried, B. M.: Primary Carcinoma of the Lung: Bronchiogenic Cancer —A Clinical and Pathological Study, Medicine **10**:373-508 (Dec.) 1931.

12. Cited by Fried.[11]

Hence, epithelial tumors of the trachea may contain any or all of these cell types or may consist of a reproduction of the basal cells. Likewise, as these basal cells are embryonic and generative, they are capable of giving rise to squamous cells. This last point has been emphasized by such authorities as Borst [12] and Krompecher [13] and has provided the best explanation for "metaplasia." Because "metaplasia" would indicate the transformation of one cell type into another, the term is being discarded in favor of the expression "protoplasia," which correctly indicates the germinal cell origin of the altered epithelium.

Thus, the original conception of Virchow [12] concerning metaplasia of one type of cell into another is no longer tenable. Also, the hypothesis of Cohnheim,[12] according to which cell enclavements or nests of cells are held responsible for the presence of squamous epithelium on visceral linings, is considerably less valid. Of interest in this connection are the studies of Wolbach and Howe,[14] who were able to demonstrate the keratinization of epithelial surfaces in animals deprived of fat-soluble vitamin A. The significance of this widespread keratinization is not understood. It has been repeatedly observed that chronic infections of the lung, pneumonia, influenza and whooping cough are accompanied by protoplasia of columnar to squamous epithelium. It is likewise asserted that malignant neoplasms are likely to develop where "metaplasia" has taken place, and this, of course, lends support to the concept that carcinoma develops at the site of a previous irritation (Virchow)—that is, where regenerative processes are taking place.

HISTORICAL ASPECTS

In 1767, Lieutaud [15] described the first tumor of the trachea discovered at autopsy. The character of the tumor was not mentioned. In 1857, Rokitansky [15] described the gross appearance of a carcinoma of the trachea. In 1861, Turck [15] reported a tracheal tumor which he had seen with a laryngeal mirror. In 1871, both Langhans [16] and Schroetter [15] described malignant tumors of the trachea and presented histologic findings. In 1897, Killian [15] observed a tracheal tumor with his bronchoscope.

Reviewers have stressed the rarity of tracheal tumors. Schmidt [15] reported that in 42,635 cases there were 2,088 tumors of the upper

13. Krompecher, E.: Zur Kenntnis der Basalzellerkrebse der Nase, der Nebenhöhlen, des Kehlkopfes und der Trachea, Arch. f. Laryng. u. Rhin. **31**: 443-460, 1918; Ueber Gesetzmässigkeiten im Aufbau der Krebse, Ztschr. f. Krebsforsch. **22**:410-421 (Aug.) 1925.

14. Wolbach, S. B., and Howe, P. R.: Vitamin A Deficiency in the Guinea-Pig, Arch. Path. **5**:239-253 (Feb.) 1928.

15. Cited by Baratoux.[3]

16. Cited by Leroux-Robert.[2]

air passages, 748 tumors of the larynx and only 3 tumors of the trachea. In 1908, Chiari [15] stated that of 140,000 patients seen, 1,329 had tumors of the larynx and 9 had tumors of the trachea. The autopsy records of some of the largest hospitals in the world reveal the occurrence of only 1 or 2 tracheal tumors among thousands of cadavers examined. A summary of the figures presented shows that the ratio of laryngeal to tracheal tumors is about 100 to 1. The rarity of tumors of the trachea has been explained [17] by the simple structure, immobility and passive function of the organ.

STATISTICAL DATA

In a recent paper on carcinoma of the trachea, Culp [1] stated that there are 433 recorded instances of tracheal tumor. One hundred and forty-seven of the tumors were designated as carcinomas. In evaluating this group of 147 carcinomas, he found that accurate histologic findings were described in only 82 instances. Since Culp's review, 4 additional case reports have appeared in the literature, those of Keeney [18] (adenocarcinoma), Rathbone [19] (basal cell carcinoma), Gotô and Kyo [20] (basal cell carcinoma) and Robin and Mann [21] (squamous cell carcinoma). The 9 previously unreported cases from the Mayo Clinic are included in this paper. There is a total, therefore, of 95 carcinomas of the trachea which have been described histologically. Of these 95 tumors, 42 were squamous cell carcinomas, 43 were adenocarcinomas and 10 were basal cell carcinomas.

In the cases collected from the literature the degree of malignancy of the tumors was not indicated. In the series of 15 cases reported from the Mayo Clinic the neoplasms were graded according to the system designated in table 1.

In this paper, emphasis has been placed on the histologic differentiation and the degree of malignancy of the carcinomas involved. It is apparent that these factors are of prime importance in evaluating the efficacy of therapy. It is to be noted that adenocarcinoma and squamous cell carcinoma of the trachea occur with almost equal frequency.

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17. Chevallier, R.: Cancer primitif de la trachée à début dysphagique, Lyon méd. **146**:309-315 (Sept. 14) 1930.

18. Keeney, E. L.: Primary Carcinoma of the Trachea with Cutaneous Carcinomatosis, Bull. Johns Hopkins Hosp. **61**:411-420 (Dec.) 1937.

19. Rathbone, R. R.: Primary Carcinoma of the Trachea. Rev. Tumor Therapy **1**:66-68 (Aug.) 1937.

20. Gotô, J., and Kyo, K.: Ein Fall von Basalzellenkrebs, dessen Ursache in ueber jährigem Gebrauch der Trachealkanuele zu liegen scheint, Taiwan Igakkai Zasshi **35**:1469 (July) 1936.

21. Robin, I. G., and Mann, W. N.: Carcinoma of the Trachea: Commentary on a Case, Guy's Hosp. Rep. **87**:318-331 (July) 1937.

SITUATION OF THE TUMORS

The data on the situation of tracheal carcinomas have been well summarized by both Culp [1] and Baratoux.[3] About half of all tumors considered by these authors were situated in the lower third of the trachea, about 35 per cent in the upper third and the remaining 15 per cent in the middle third. More than half of the tumors were situated on the posterior wall of the trachea. The remaining tumors developed on the anterior or lateral walls, were annular or partially encircled the trachea.

An analysis of the series studied at the Mayo Clinic, which includes 1 case in which autopsy was done elsewhere, shows that of the 16 cases the tumors were located in the upper third of the trachea in 5, in the middle third in 3 and in the lower third in 6 instances. In 1 instance the tumors were multiple and were dispersed throughout the trachea. In the remaining instance both the middle and the lower third of the

TABLE 1.—*Grade and Type of Lesion in Fifteen Patients with Carcinoma of the Trachea at the Mayo Clinic*

Grade	Adenocarcinoma	Squamous Cell Carcinoma	Total
1	5	1	..
2	1	1	..
3	1	2	..
4	2	2	..
Total	9	6	15

trachea were involved. The posterior and lateral walls of the trachea were involved jointly in 5 instances. The lateral walls only were the site of tumor masses in 5 instances. Joint involvement of the anterior and lateral walls of the trachea afflicted 2 patients. Two annular tumors and 1 tumor situated entirely in the anterior wall of the trachea were encountered.

While the figures thus evolved at the Mayo Clinic are not of statistical value by themselves, they tend to substantiate the conclusions of previous reviewers as to the site of the lesions. Briefly, carcinoma of the trachea occurs most frequently in the lower third of the trachea and on the posterior and lateral walls and least often in the middle third and on the anterior walls.

Various explanations have been given for this localization of tumors. Simmel [22] and also Teuber [23] have stated the opinion that the region

22. Simmel, E.: Zur Kasuistik des primären Carcinomas der Trachea, Arch. f. Laryng. u. Rhin. **24**:449-453, 1910.

23. Teuber, K. H.: Das primäre Carcinom der Trachea, Ztschr. f. Hals-, Nasen- u. Ohrenh. **33**:444-458, 1933.

of bifurcation of the trachea is most exposed to trauma and hence is more subject to the formation of a tumor. The middle portion of the structure is immobile and is not subject to the irritations affecting the upper and the lower part. The predilection of the tumor for the posterior wall is explained by the rich glandular structure of this part of the trachea. Strauss [24] has demonstrated that lymph channels encircle the trachea between the cartilaginous rings and provide for drainage to the posterior wall, where lymph trunks form and accompany the recurrent laryngeal nerves. Likewise, Strauss showed that the number of lymph vessels is much greater in the inferior portion of the trachea. Furthermore, the cartilaginous rings offer successive lines of resistance against the lymphatic spread of infections or neoplastic processes up or down the trachea.

PERITRACHEAL INVOLVEMENT AND METASTASES

The subject of metastasis of tracheal carcinoma has been disputed. Stenn [25] stated that metastasis occurs in about 50 per cent of cases, while Robin and Mann [21] have maintained that metastasis even to the neighboring lymph glands is rare. Simpson and Moore [26] noted the occurrence of metastases in 17 of the 27 cases of carcinoma of the lower part of the trachea collected by them.

The presence or absence of metastasis was noted by Culp [1] in 91 cases. Extension of the tumor beyond the limits of the trachea was specified in 62 and denied in 29 cases. The overwhelming proportion of such metastases occurred in the neighboring lymph nodes. Breslich [27] stated that the order of frequency of metastases is as follows: peritracheal, cervical and tracheobronchial lymph nodes, lungs, liver, supraclavicular and axillary nodes, esophagus, spleen, pancreas, kidneys and skeletal structures. Breslich's observation agrees well with the observations of Baratoux,[3] Broman,[28] Stenn [25] and Simpson and Moore.[26] Direct invasion is the most frequent and most important method of metastasis. Involvement of the anterior wall of the esophagus is common, and dysphagia is often the first symptom of the disease. Involve-

24. Strauss, J. F.: The Intimate Lymphatics of the Trachea, Ann. Otol. Rhin. & Laryng. **31**:715-737 (Sept.) 1922.

25. Stenn, F.: Carcinoma of the Trachea: Review of Recent Literature and Report of a Case, Arch. Otolaryng. **21**:190-198 (Feb.) 1935.

26. Simpson, W. L., and Moore, R. M.: Primary Colloid Adenocarcinoma of the Lower Third of the Trachea, Ann. Otol., Rhin. & Laryng. **43**:1133-1138 (Dec.) 1934.

27. Breslich, P. J.: Squamous Cell Carcinoma of the Trachea, J. Cancer Research **14**:144-151 (March) 1930.

28. Broman, J. R.: Primary Carcinoma of the Trachea, with Report of a Case and Review of the Literature, J. Cancer Research **8**:394-408 (Oct.) 1924.

ment of the adjacent lymph nodes is of particular interest in view of the lymphatic drainage of the trachea. As has been noted, the lymphatic vessels follow the recurrent laryngeal nerves. Hence, lesions situated near the bifurcation of the trachea with involvement of the mediastinal lymph nodes may result in compression of the left recurrent laryngeal nerve and paralysis of the left vocal cords. Lesions situated high in the trachea may metastasize to the cervical nodes and may compress both recurrent laryngeal nerves, producing bilateral palsy of the vocal cords.

Distant metastases resulting from carcinoma of the trachea are not common. One patient in our series suffered from a metastatic mass situated in the left frontal region. Keeney [18] recently reported a case in which the patient had widespread cutaneous metastases. Of Fraenkel's [29] 8 subjects examined at autopsy, 1 had pancreatic metastasis, another had splenic metastasis and a third had skeletal metastasis.

Instances of involvement of the tracheal cartilages are unusual. Such instances have been reported, however, by Stenn [25] and by Robin and Mann.[21]

AGE AND SEX INCIDENCE

Of 116 patients with carcinoma of the trachea whose age and sex were given, the lesion occurred in 100 between 30 and 70 years of age, and the incidence was approximately equal in each of the four decades represented. Seventy-three of the 116 patients were males and 43 were females. This distribution in age is in approximate agreement with the ratio of 2 to 1 expressed by several observers. Robin and Mann's [21] ratio was 2 to 1; D'Aunoy and Zoeller's [6] ratio was 2.3 to 1, and Broman's [28] ratio was 1.6 to 1.

In the series studied at the Mayo Clinic there were 9 females and 7 males, and the ages ranged from 29 to 77.

SYMPTOMS

The symptoms of carcinoma of the trachea are caused chiefly by the action of a group of mechanical factors. This fact has been stressed in a recent paper on tumors of the trachea by Jackson.[30] The most common and the most urgent complaint of the patient with a tracheal tumor is shortness of breath. Dyspnea occurs because the tracheal lumen is invaded by the growth. This particular type of dyspnea is similar to that caused by any lesion that obstructs the upper air passages. Such

29. Fraenkel, E.: Ueber Luftröhrenkrebs, Deutsches Arch. f. klin. Med. **135**: 184-207 (Feb.) 1921.

30. Jackson, C.: Tumors of the Trachea, South. Surgeon **5**:263-276 (Aug.) 1936.

a type of obstructive dyspnea causes an easily recognizable stridor like that caused by a laryngeal lesion or an aspirated foreign body. Vinson [31] stated that lesions of the larger bronchi likewise cause stridor.

Dyspnea which is the result of tracheal tumors is frequently paroxysmal and occurs most often at night or when the patient lies down. The degree and nature of the dyspnea depend on the size and location of the lesion. Pedunculated tumors may be responsible for respiratory difficulty which may be either chiefly inspiratory or chiefly expiratory. Inspiratory obstruction tends to produce pulmonary atelectasis. Expiratory obstruction results in emphysema. If the lesion is at or near the tracheal bifurcation, one lung or the other is likely to suggest evidence of obstruction of its airway. Sessile tumors are equally likely to cause an impairment of the intake and output of air. Jackson [30] pointed out that with inspiration and expiration there is an increase and decrease in the lumen of the trachea and in those of the bronchial tubes. Hence, if partial obstruction of the trachea occurs, emphysema is likely to result. This point has also been stressed by Dumas and Guichard.[5] These factors help to explain the paroxysmal nature of the type of dyspnea which accompanies carcinoma of the trachea. Respiratory crises can be precipitated by infection and accumulation of secretion as well as by spasm of the bronchi and of the trachea.

Cough is present in nearly all instances. At the onset it is usually nonproductive, but eventually it is accompanied by expectoration of mucopurulent sputum. The obstructive factor is most often responsible for the retention of pulmonary secretions. Tracheobronchitis is almost always present and is sometimes accompanied by bronchiectasis of varying severity. The sputum is often bloody; at times there is profuse hemoptysis.

Thus, the obstructive factor of carcinoma of the trachea may be responsible for shortness of breath (either constant or paroxysmal or both, but in any instance progressive), a crowing or wheezing type of respiration, atelectasis or emphysema, cough, expectoration, pneumonia and hemoptysis. Thomson [32] declared that the patient most often dies from asphyxia, pneumonia or hemorrhage.

Most tracheal carcinomas encroach on the tracheal lumen. Many of them, however, invade peritracheal tissues. Lesions of the posterior wall or "party wall" of the trachea may extend well into the esophagus. In

31. Vinson, P. P.: Primary Malignant Disease of the Tracheobronchial Tree: Report of One Hundred and Forty Cases, J. A. M. A. **107**:258-261 (July 25) 1936.

32. Thomson, St. C., cited by Robin and Mann.[21]

a certain number of instances the patient complains of dysphagia. In some instances esophagoscopic examination has been carried out.[33]

Metastasis of tracheal carcinoma to the adjacent lymph nodes is rather common. As has been stated, the lymphatic drainage system of the trachea is closely related anatomically to the recurrent laryngeal nerves. It is not surprising, therefore, that involvement of the mediastinal lymph nodes results in paralysis of the left vocal cord, whereas involvement of lymph nodes situated higher than those of the mediastinum may cause palsy of either or both cords. Thus, hoarseness is at times a symptom of tracheal cancer.

Other symptoms are less common and are evidences of more distant metastasis. Pain is infrequent. When the cervical nodes are involved, extension either to the axilla to involve the brachial plexus or to the paravertebral region to involve the sympathetic chain may occur. Paresthesias of the upper extremities and also Horner's syndrome have been noted. Mediastinal enlargement may result in obstruction of the venous return, causing distention of the veins of the head and neck.

DIAGNOSIS

The existence of carcinoma of the trachea may be suspected from the clinical history and the results of the physical examination; this does not often happen, however, because of the rarity of the condition. Tumors of the larynx or of the lung are considered likely possibilities when the patient presents himself for examination. In most instances a diagnosis of asthma is made at some stage of the disease. This is particularly true when the tumor has produced obstructive emphysema. It is well to recall Jackson's [30] pertinent aphorism, "All is not asthma that wheezes." The paroxysmal nature of the dyspnea likewise misleads the physician. Other conditions frequently suspected are carcinoma of the thyroid, mediastinal tumor, tuberculosis, cardiac disease and chronic bronchitis. Some such disease as bronchiectasis, pneumonia, atelectasis or emphysema (any of which may result from the tracheal obstruction) is often considered the primary condition.

Roentgen examination of the thorax may disclose evidence of mediastinal enlargement or peripheral pulmonary disease but does not often help in the recognition of tracheal tumor. Roentgen study of the trachea in the lateral view may disclose invasion of the tracheal lumen. The

33. (*a*) Gilfoy, F. E.: Primary Malignant Tumors of the Lower Third of the Trachea: Report of a Case with Successful Treatment by Electrofulguration and Deep X-Rays, Arch. Otolaryng. **16**:182-187 (Aug.) 1932. (*b*) Guisez, J.: Du cancer primitif de la trachée et des grossez bronches, Bull. d'oto-rhino-laryng. **18**:9-21, 1919-1920. (*c*) Harris, T. J., and Forbes, H. H.: Carcinoma of the Trachea, Laryngoscope **35**:53 (Jan.) 1925. (*d*) Chevallier.[17] (*e*) Stenn.[25]

technic of such examinations has been discussed by Saupe,[34] Lachapèle,[35] Ellinger [36] and Weiss and Biermann.[37] Lateral roentgenograms aided in the diagnosis of 2 tracheal carcinomas in our series.

Tracheal tumors at times can be visualized by means of the laryngeal mirror. In 4 cases at the Mayo Clinic the diagnosis was postulated by this means. In nearly all instances, however, the use of the bronchoscope is essential to the diagnosis. For 13 of our 16 patients the diagnosis was definitely established by tracheoscopic examination, and in 9 instances there was no hint as to the real condition until the tracheoscopic examination had been performed.

The appearance of the lesion as seen through the bronchoscope is variable. Frequently an ulcerating tumor mass is seen. Sometimes a grayish white or reddened nodule is the only finding. The tracheal mucosa is usually ulcerated at some point. Regardless of the gross appearance of the tumor visualized, however, microscopic examination of a specimen taken for biopsy removed through the bronchoscope is essential for an accurate diagnosis.

PROGNOSIS

The prognosis of carcinoma of the trachea is unfavorable. Review of the cases reported in the literature reveals that most of the patients thus afflicted die within six to eighteen months after they are seen by the physician. The diagnosis in the majority of these cases was not made during the life of the patient; hence no treatment was given. Generally, when the correct diagnosis was made the condition was far advanced. The relatively early obstruction to respiration and the occurrence of secondary pulmonary disease, such as pneumonia, abscess of the lung, atelectasis or emphysema, hasten death. As has been stated, death most frequently results from suffocation, pneumonia or hemorrhage. As a rule the patient's general physical condition remains fairly good until the terminal phase of the disease.

Treatment of carcinoma of the trachea is difficult and, on the whole, unsatisfactory. Reports in the literature indicate that in most instances treatment was unavailing or afforded only temporary benefit.

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34. Saupe, E.: Beitrag zur röntgenologischen Darstellung von in die Trachea einbrechenden Tumoren, Röntgenpraxis **8**:156-159 (March) 1936.

35. Lachapèle, A. P.: Sur un case de tumeur de la trachée, Bull. et mém. Soc. de radiol. méd. de France **24**:467-468 (May) 1936.

36. Ellinger, E.: Zur Röntgendiagnose der Trachealtumoren, Fortschr. a. d. Geb. d. Röntgenstrahlen **54**:226-230 (Sept.) 1936.

37. Weiss, T., and Biermann, E.: Ein intratrachealer Tumor, der röntgenologisch diagnostiziert und auf endobronchialem Weg entfernt werden konnte, Röntgenpraxis **4**:309-312 (April) 1932.

For illustrative purposes, a study was made of observations on 38 cases collected from the literature; specific treatment for a definite tracheal carcinoma was attempted. Eighteen of the 38 patients were dead when the reports were published. Only 2 of these survived more than one year. The cases of 13 of the 20 living patients were reported within eight months from the time of treatment.

Of these 38 patients, 6 had squamous cell carcinomas, 12 had adenocarcinomas and 6 had basal cell carcinomas. Five of the 6 patients with squamous cell tumors were reported as dead, and the remaining patient was reported alive, six months after treatment. Of the 12 patients with adenocarcinomas, 6 were dead and 6 were alive at the time the reports were published. Of the patients with basal cell tumors, 5 were alive

TABLE 2.—*Type of Treatment and Number of Patients Surviving in a Series of Thirty-Eight Cases of Carcinoma of the Trachea in the Literature*

Type of Treatment	Patients Living	Patients Dead
Simple removal	9	9
Simple removal and radium therapy	2	4
Simple removal and roentgen therapy	1	0
Radium therapy alone	1	3
Roentgen therapy alone	1	2
Resection of the trachea	6	0
Total	20	18

and 1 was dead. These figures would indicate that squamous cell carcinomas are more malignant and less amenable to treatment than are glandular and basal cell carcinomas.

Another point of interest is the situation of the lesion as correlated with the results of treatment. Of the patients reported as living, 14 had lesions in the upper third of the trachea and 5 had lesions in the lower third. On the other hand, of the patients who died after treatment, 7 had lesions in the upper third of the trachea, 9 had lesions in the lower third and 2 had tumors situated in the middle third. As might be expected, the prognosis in general appears to be somewhat more favorable when the tumor is situated in the upper portion of the trachea.

Detailed information as to the type of treatment used for these 38 patients was frequently lacking. The term "simple removal" was used to designate the treatment of patients from whom the tumor or part of the tumor was removed with the surgical knife through a tracheotomy wound or to designate instances in which portions of the tumor were obtained with the endoscopic forceps through the bronchoscope. In a few instances [33a] the tumors were fulgurated with diathermy. Table 2

is a résumé of the treatment used for 38 patients whose records were collected from the literature, together with the results obtained.

Table 3 is presented to evaluate the treatment employed for 16 patients with carcinoma of the trachea encountered at the Mayo Clinic (1 of these was not treated at the clinic).

It is to be noted that of the 15 patients treated at the Mayo Clinic 7 died within eleven months after they were first seen there. One additional patient died of unknown causes at least five years after his tracheal carcinoma had been treated. Of this group, 7 patients are now living after treatment.

The following facts must be noted concerning the patients who died. Two patients (cases 6 and 13) were in such a hopeless condition when encountered at the clinic that no treatment could be administered. Both died within two months after consultation. One patient (case 14) had metastasis to the left frontal region when he was first encountered. He was given palliative roentgen treatment; he died in two months. Two patients (cases 5 and 15) were given treatment with roentgen rays and obtained temporary benefit, but both died subsequently. Tracheotomy was performed on 1 patient (case 4), and the tumor was fulgurated with surgical diathermy. He improved temporarily, but metastases developed and he died eight months later. One patient (case 11) was treated by implantation of radium directly into the tumor and subsequently was given treatment with roentgen rays. About two weeks later this patient had a profuse pulmonary hemorrhage and died. Of the 7 patients who died, 3 had squamous cell carcinomas (2 were graded 4 and 1 was graded 2 according to Broders' index). The other 4 patients had adenocarcinomas (2 were graded 4, 1 was graded 3 and 1 was graded 2).

In reviewing the histories and observations concerning the 7 living patients, the following facts are of interest: The interval since treatment of these patients varies from nine months to nine and a half years. The patient (case 10) who underwent resection of the larynx and trachea has been well for eighteen months at the time of writing. She is expecting to return to the Mayo Clinic for reexamination. The patient in case 12 has been entirely well since treatment with surgical diathermy and roentgen rays without additional therapy. The patient in case 7 has been entirely well for five and a half years. This patient returns at periodic intervals for bronchoscopic examination, and on several occasions cauterization of recurrent tumor tissue has been performed. At the most recent examination no tumor was found. The patient in case 2 has been well since his tracheal tumor was last fulgurated, eighteen months prior to the writing of this paper. The patient in case 1 has been well since surgical diathermy was performed, nine months before the time of writing. The patient in case 8 is well eight years after her

TABLE 3.—*Résumé of Sixteen Cases of Carcinoma of the Trachea Encountered at the Mayo Clinic from 1921 to 1939*

Case	Sex of Patient	Age of Patient	Diagnostic Method	Treatment	Result	Survival After Treatment*	Lesion	Location of Lesion
1	F	59	Bronchoscopic	Surgical diathermy	Well	9 months	Squamous cell carcinoma grade 1	Lower third
2	M	35	Roentgenologic, bronchoscopic	Forceps removal; diathermy	Alive, good health	18 months	Adenocarcinoma grade 1	Middle third, right anterolateral walls
3	F	32	Roentgenologic, bronchoscopic	Roentgen therapy	Alive, well	2 years	Adenocarcinoma grade 1	Upper third, posterior and right lateral walls
4	M	51	Bronchoscopic	Surgical diathermy, tracheotomy, roentgen therapy	Metastasis, death	8 months	Squamous cell carcinoma grade 4	Upper third, posterior and lateral walls
5	F	36	Bronchoscopic	Roentgen therapy	Death	11 months	Adenocarcinoma grade 4	Middle, lower thirds; posterior and right lateral walls
6	M	57	Laryngoscopic	.....	Death, pneumonia	2 months	Adenocarcinoma grade 3	Middle third (annular)
7	M	65	Bronchoscopic	Diathermy, some roentgen therapy	Alive, well	5½ years	Adenocarcinoma grade 1	Lower third, right lateral wall
8	F	30	Bronchoscopic	Roentgen therapy (one treatment)	Alive, good health	8 years	Squamous cell carcinoma grade 3	Multiple
9	M	50	Roentgenologic, laryngoscopic	Tracheotomy; radium	Improved	Died, 5 to 10 years	Adenocarcinoma grade 1	Upper third, anterior wall
10	F	44	Bronchoscopic; tracheotomy performed	Resection of trachea and larynx	Alive	1½ years	Adenocarcinoma grade 1	Upper third, right lateral and posterior walls
11	F	43	Bronchoscopic	Roentgen therapy	Improved, died	6 months	Adenocarcinoma grade 2	Lower third, anterior and left lateral walls
12	F	29	Laryngoscopic	Tracheotomy; surgical diathermy; roentgen therapy	Alive, well	9½ years	Squamous cell carcinoma grade 3	Middle third, posterior and right lateral walls
13	F	46	Bronchoscopic	.....	Died	2 months	Adenocarcinoma grade 4	Lower third, right lateral wall
14	M	46	Bronchoscopic	Roentgen therapy; tracheotomy	Died	2 months	Squamous cell carcinoma grade 4	Lower third, right lateral wall
15	F	42	Laryngoscopic; bronchoscopic	Tracheotomy; radium; roentgen therapy	Pulmonary hemorrhage, died	2 weeks	Squamous cell carcinoma grade 2	Lower third, right lateral wall
16	M	77	.....	None	Died	9 months	Not known	Upper third (annular)

* At the time of writing of this paper.

visit to the Mayo Clinic. The disappearance of this patient's tumor after one treatment with roentgen rays is difficult to explain.

In 8 patients who responded well to treatment the types of tumors observed were as follows: 1 multiple squamous cell carcinoma (grade 1), 2 squamous cell carcinomas (both grade 3) and 5 adenocarcinomas (all grade 1).

COMMENT

The conclusions which may be drawn from the study are clear. Squamous cell tumors are much less amenable to treatment than are adenocarcinomas. The efficacy of treatment is inversely proportional to the grade of malignancy of the tumor, grade 1 being most amenable to treatment and grade 4 least amenable (5 of the 8 patients treated successfully had grade 1 adenocarcinomas). The most important single factor in the establishment of a prognosis is the relative malignancy of the tumor in question. The relative proportion of differentiated cells is a good criterion of the degree of malignancy.

Obviously, no sweeping conclusions can be drawn as to the treatment of choice for carcinoma of the trachea. Many patients present themselves during advanced stages of the disease, and medical measures, emergency tracheotomy or palliative roentgen treatment are the only possible methods of therapy. The situation and extent of the lesion and the presence or absence of metastases are factors which govern the success or failure of any type of therapeutic endeavor. Widespread lesions are much less amenable to treatment than are localized tumors. Carcinomas of the upper portion of the trachea are ordinarily more accessible than are tumors in the lower part of the trachea. Papillomatous lesions are more easily removed than are lesions which infiltrate the walls of the trachea and invade the surrounding tissues. Such factors will influence the selection of treatment for each patient.

Provided the circumstances are favorable, carcinoma of the trachea is by no means a hopeless condition. The outlook is not always gloomy if an early diagnosis can be made. An accessible tumor of a low grade of malignancy and of a glandular cell type frequently can be eradicated. It is possible to remove portions of the tumor with forceps through the bronchoscope or to excise the tumor through a tracheotomy wound. Subsequent cauterization of the remaining tumorous tissue and of the base of the tumor with surgical diathermy may be performed. Implantation of radon seeds or administration of roentgen therapy may be utilized to supplement the treatment. Periodic bronchoscopic examination may suggest the necessity of further cauterization. For 4 patients of the Mayo Clinic such procedures have resulted in permanent beneficial results over periods of several years. These patients are clinically cured.

Favorable results may be obtained by resection of the trachea as is illustrated by the treatment of 6 patients reported on in the literature and that of 1 patient of the Mayo Clinic. The disfigurement, vocal impairment and constant menace of pulmonary infection are disagreeable accessory results which make such radical surgical treatment undesirable.

The use of roentgen rays as the only treatment for carcinoma of the trachea has been advocated by some authorities. Rathbone [19] reported the apparent cure of a patient with a basal cell carcinoma by this means. Baratoux [3] presented 2 cases in which the patients were markedly improved by roentgen therapy. Ellinger [36] expressed approval of this method of treatment. In some instances roentgen rays have been used in addition to diathermy or surgical removal of the carcinoma.

It has been pointed out [30] that the use of roentgen rays or radium results in perichondritis and necrosis of the tracheal cartilages. This occurrence may well account for the sudden death of a number of patients who received repeated doses of roentgen rays. The patient reported on by Vinson and Leddy [9] (included in the present series) was given roentgen treatment only. She made a remarkable improvement but died rather suddenly about three months after the final course of therapy. However, 2 patients in the series under consideration were benefited by roentgen treatment and are living at the time of writing; 1 is living eight and 1 two years after cessation of therapy. Neither of them received massive doses. One of them has had repeated roentgen treatment at intervals of several months. The life of 1 patient was prolonged several years by means of repeated external applications of radium.

SUMMARY AND CONCLUSIONS

Sixteen patients with carcinoma of the trachea encountered at the Mayo Clinic from 1921 to 1937 are reported on, and the literature on primary carcinoma of the trachea is reviewed. An attempt is made to correlate the pathologic, clinical and therapeutic aspects of this condition. The following points are emphasized:

1. The diagnosis of tracheal carcinoma is made most readily by means of bronchoscopic examination. This procedure should be carried out in any instance in which obstruction of the upper air passages is not explained or in which there is no obvious reason for hoarseness of the patient or paralysis of the vocal cords.

2. Specimens for biopsy should be taken from the tumor. It is important to determine whether the carcinoma is of glandular or squamous cell type. The degree of malignancy of the tumor should be estimated.

3. The relative malignancy of a carcinoma may be ascertained by grading the tumor according to the method of Broders. The classification of carcinomas into four grades is made on the basis of the ratio of differentiated to undifferentiated cells.

4. Although the prognosis for carcinoma of the trachea is admittedly poor, there are occasions when accessible tumors of the glandular cell type of a low grade of malignancy are amenable to treatment.

5. Local removal and cauterization with surgical diathermy appear to be the most efficacious methods of treatment. These procedures may be carried out through the bronchoscope or through a tracheotomy wound.

6. Surgical resection of the trachea is the treatment of choice when tumors of the squamous cell type or of a high grade of malignancy are encountered. Treatment with roentgen rays or implantation of radon seeds may be of definite value in some instances.

Case Reports

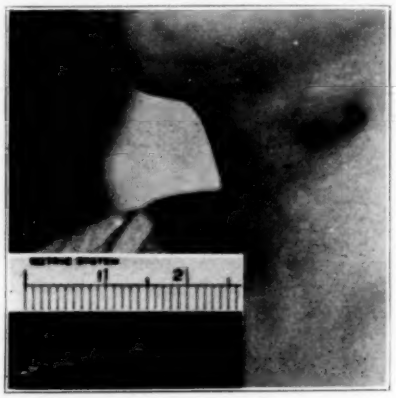
CERVICAL ABSCESS RESULTING FROM UNUSUAL FOREIGN BODY IN THE PHARYNX

LEWIS E. ETTER, M.D., WARRENDALE, PA.

The following case is believed of interest because what at first appeared to be the localization of an abscess in the cervical glands secondary to recurrent infection of the throat turned out to be an abscess from swallowing a stalk of June grass.

A. D., aged 15, living on a farm, suffered from symptoms of infection of the throat intermittently for three months before what seemed to be cervical adenitis of the left anterior cervical glands developed.

On April 15, 1938, he was first seen and was treated for acute tonsillitis, of which he showed typical local and general symptoms, with a temperature of 101



Cervical abscess resulting from a foreign body in the pharynx. Inset, the foreign body.

F. and a pulse rate of 100. He was kept in bed five days, after which time the throat had greatly improved, but he returned to the office two days later with a peritonsillar abscess breaking spontaneously and draining completely.

On May 31 he returned for treatment of subacute pharyngitis and was discharged as cured two days later. With this infection he did not have fever or adenitis. There was no complaint of tickling in the throat or any cough at the time.

During the month of June he began to complain of a swollen neck and a sore throat and of general malaise, but he did not come for treatment until July 5. During this time there was no cough or tickling sensation in the throat. Examination disclosed a large indurated mass to the left of the thyroid cartilage, extending backward to the sternocleidomastoid muscle and upward to the mandible. There was marked stiffness of the neck, the patient being unable to rotate the head without turning the whole body, and there was considerable dysphagia.

The swelling was interpreted as being due to acute cervical adenitis secondary to the previous infections. The patient was put to bed and moist heat applied to his neck, after which the induration gradually subsided and the temperature returned to normal. By July 13 an area of softening developed 5 cm. to the left of the midline, which was incised and drained of a small amount of pus. The swelling continued to subside, but medial to the first incision another area of softening developed, which was drained several days later of a small amount of blood and pus.

After this the swelling reduced to a small indurated mass directly under the incisions. The medial one stopped draining and closed in a few days, but the lateral one continued to ooze thin pus and took on the appearance associated with chronic infection of a sinus.

Examination on July 30 showed a small piece of what appeared to be vegetable matter protruding from the opening of the first incision, traction on which resulted in withdrawal of the head of a stalk of June grass, proximal end first.

Further questioning of the boy elicited that he frequently not only chewed the proximal ends of grass stems, as many people do, but ate the top of the stalk as well. It is remarkable that the piece obtained could have lodged in his throat and perforated the pharyngeal wall without at some time having produced tickling or local irritation of the throat. The grass probably was arrested in the hypopharynx where it is narrowest, just before it merges with the esophagus, and eroded through the wall and the cervical fascia to the tissue space anterior to the carotid sheath, where the abscess formed and localized.

The confusing coincident symptoms at onset and the evolution in this case suggest an unusual possibility to be kept in mind in the differential diagnosis and the study of the causes of cervical abscess.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology.

THE PARANASAL SINUSES

MALIGNANT TUMORS

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CHICAGO

(Concluded from page 479)

Ringertz' [128] monograph is based on a study of the pathologic material of Sabbatsberg's Oto-laryngological Clinic and Radiumhemmet of Stockholm as well as a large material drawn from outlying districts. Between 1921 and 1935, 391 patients with malignant tumors of the sinuses were treated. The clinical observations have been discussed by Oehngren, Holmgren, Berven and Ahlbom in previous publications. Nineteen different types of tumor were found, squamous cell carcinoma being found in the largest single group, numbering 218. The article, which is well illustrated, is replete with descriptions of various types of tumors, particularly the unusual tumors, such as cylindroma, reticulocytoma, plasmocytoma, Ewing's tumor and malignant melanoma. A brief clinical record of each of the 391 cases is extremely helpful in evaluating the histopathologic observations as described by the author. The monograph is an excellent piece of work, worthy of study, and should prove very useful for reference.

New [129] reviews his own statistics on carcinoma of the antrum and upper jaw as published in 1935, showing 53.8 per cent five year cures; also Oehngren's statistics of 1937, showing 35 per cent five to twelve year cures. He comments on the improvement in results over previously published statistics, which he attributes to earlier diagnosis, more thorough surgical exposure, use of surgical diathermy and postoperative use of radiation. He also makes a point of thorough eradication at the first attempt, disregarding the possible facial deformity, particularly in view of the excellent results of subsequent plastic reconstruction.

Szende [130] reports on the material studied in Verebely's clinic at Budapest over a seventeen year period. There were 70 cases of malig-

128. Ringertz, N.: Pathology of Malignant Tumors Arising in the Nasal and Paranasal Cavities and Maxilla, Acta oto-laryng., 1938, supp. *27*, p. 1.

129. New, C. B.: Malignant Diseases of the Paranasal Sinuses, Am. J. Surg. **42**:170 (Oct.) 1938.

130. Szende, B.: Die bösartigen Geschwülste der Nasennebenhöhlen, Monatschr. f. Ohrenh. **72**:925 (Oct.) 1938.

nant disease of the sinuses, in 63 of which the diagnoses were carcinoma and sarcoma. The earliest symptom usually was pain referred to the teeth or the face. In many cases the malignant condition was discovered after extraction of a tooth. Slight trismus due to spasm of the internal pterygoid muscle proved to be an unfavorable symptom. In 4 cases there was a history of previous operation for polyp, and in 4 cases the earliest symptom was nasal hemorrhage. In most of the cases, however, there was little or no indication of the growth until it had assumed a rather large size. In 26 cases there was associated suppuration in the sinuses. In 14 of 34 instances carcinoma of the antrum affected the orbit, causing exophthalmos. The treatment followed was radical excision with subsequent irradiation of the involved region. In 7 cases the lesion could not be completely extirpated because of extensive involvement. In 9 cases the external carotid artery was tied. Partial resection of the maxilla was done in 16 cases, a complete resection with sphenoethmoid exenteration, in 27. Roentgen treatment was begun about eight to ten days later with fractional doses up to 6,000 roentgens (r). In cases of incomplete removal or of recurrence the author recommends that radium be placed in the cavity.

Spencer [131] reviews 11 cases of malignant tumor of the sinuses seen at the Colorado General Hospital from 1924 to 1936, discussing the diagnosis and treatment. He advises early removal by diathermy combined with surgical treatment, followed by applications of radium or roentgen rays, depending on the type of growth, extent and radiosensitivity. A follow-up of the patients revealed only 2 now living; 5 patients could not be reached. The author comments on the fact that clinic patients are usually seen when the tumor has reached a late stage and the prognosis is bad.

Myerson [132] found carcinoma of the sinuses in less than 1 per cent of all patients admitted to the Brooklyn Cancer Institute. There were only 5 with such cancers among the 737 admitted. He favors the approach described by New, Barnes and Greene and the combination of surgical operation, diathermy and irradiation. Advanced tumors, with swelling of the cheek, should be exposed through an external incision.

Powell [133] reports 7 of 18 patients alive and well three months to twelve years after operation. His treatment is to open the antrum

131. Spencer, F. R., and Black, W. C.: Malignant Disease of the Nasal Accessory Sinuses, with a Review of Eleven Cases, Laryngoscope **48**:77 (Feb.) 1938.

132. Myerson, M. C.: The Management of Cancer of the Nasal Sinuses, Laryngoscope **48**:615 (Sept.) 1938.

133. Powell, L.: A Report of Eighteen Consecutive Cases of Malignant Disease of the Maxillary Antrum Treated by Radium Inserted into the Cavity After Removal of the Main Mass, Roy. Berkshire Hosp. Rep. (1936-1937), 1938, p. 124.

through the anterior wall and "clear out" the main mass, sometimes using diathermy, but with no attempt at radical removal. Forty milligrams of radium screened by 5 mm. of lead is placed in the cavity and held in place fifty to one hundred hours. A second application was given in a few cases. Roentgen rays of high voltage were used in 2 cases some years after the initial treatment, with good results, although sloughing followed.

From the Manchester Radium Institute Nuttall [134] reports 167 cases of carcinoma of the palate. In 94 per cent the lesion involved the middle third, spreading to the alveolus, and in nearly all cases it invaded the antrum as well. He calls this a typical site for the origin of an antral lesion, which should be so treated regardless of the roentgenographic findings. In many of these cases the antral carcinoma was missed and the patient, having been inadequately treated, came back with a recurrence. Of 104 patients whose antrums were investigated in this group, 70 were referred with wrong diagnoses. In 55 of these the antral carcinoma was missed elsewhere but was recognized in the Manchester Radium Institute, and in 15 it was not recognized at all until recurrence had taken place. The author stresses the importance of this relationship of antral to palatal carcinoma and states that since they have recognized this fact their record in diagnosis and treatment has improved.

Jacques, Grimaud and Thomas [135] were forced to operate twice for an extensive carcinoma of the antrum which involved the medial and inferior orbital walls in a man of 68. The external approach was used in both instances, and surgical removal was followed by local application of radium. The wound healed smoothly, leaving a deep cavity lined with mucosa and extending from the unsupported bulb above down to the maxillary floor below and from the nasal septum medially to a fibrous band which was all that was left of the external wall of the sinus. Since the bulb remained in position and the vision was good, the authors contemplated no plastic reconstruction, on account of the patient's age.

Torrigiani [136] advises a permanent opening in the hard palate protected by a plate for the purpose of better surface irradiation after removal of the growth and for subsequent inspection of the cavity. If

134. Nuttall, J. R.: Carcinoma of the Palate: How Often Does It Mark Malignant Disease in the Maxillary Antrum? Brit. M. J. **1**:839 (April 16) 1938.

135. Jacques, P.; Grimaud, R., and Thomas, C.: Epithélioma de l'antre higmorien avec destruction du plancher de l'orbite: Guérison avec bonne conservation des fonctions oculaires; Résultats de trois ans d'observation, Bull. Soc. d'opht. de Paris **50**:302 (May) 1938.

136. Torrigiani, C. A.: Sobre las ventajas de una apertura permanente en el paladar óseo o en la órbita, en las operaciones por tumores malignos de las fosas nasales y senos anexos, Día med. **10**:830 (Aug. 15) 1938.

the growth is higher up, involving the ethmoid or orbit, he favors removal of the bulb and the ethmo-orbital wall for the same reasons.

A case of Ewing's tumor of the maxilla in a man of 38 is described by Pierangeli.[137] There was a history of severe trauma to the nose a year earlier, resulting in a septal hematoma and abscess. The tumor, which appeared a year later, started in the antrum and invaded the nasal cavity as well as the canine fossa and the floor of the orbit. Biopsy revealed Ewing's tumor. The growth was treated by combined intramural and external irradiation, 15 millicurie doses in the former and 24 in the latter. Temporary regression was followed by general adenopathy and local recurrence, resulting fatally.

Connor [138] reports a metastatic hypernephroma of the frontal, ethmoid and maxillary sinuses in a woman of 52. The metastasis in the sinuses was on the side contralateral to the involved kidney. The histologic report described the tumor as a "mass of epithelial cells in alveolar nests showing relatively small dark-staining nuclei and wide clear somewhat foamy cytoplasm which appears to grow out of the inner plate." Despite extensive surgical removal and massive irradiation of the region, the patient succumbed.

Satomura [139] found a large basal cell carcinoma of the frontal sinus in a man of 59. There was a history of nasal block and discharge since childhood. Three months previously a swelling appeared over the right frontal region, which at first was painless. It gradually increased in size to approximately that of a man's fist. Pains, headaches, bloody nasal discharge and impairment of vision followed. The tumor could not be completely removed, as it had already invaded the dura.

Asano [140] reports epithelioma of an extraoral salivary gland which was discovered in the ethmoid region. The findings were nasal block, hemorrhage, a dense elastic tumor in the right nasal cavity and roentgen indications of an ethmoid origin. The mass was removed by external operation.

Bachi's [141] case was that of a squamous cell carcinoma involving the sphenoid and ethmoid sinuses and the base of the brain in a woman of 48. There was a history of some trauma to the nose about a year before. The onset was indicated by failing vision, headache and exophthalmos.

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137. Pierangeli, C. E.: Il sarcoma di Ewing del mascellare, Oto-rino-laring. ital. **8**:133 (April) 1938.

138. Connor, C. E.: Metastatic Hypernephroma of the Right Frontal, Ethmoid and Maxillary Sinuses, Arch. Otolaryng. **28**:994 (Dec.) 1938.

139. Satomura, T.: Ein Fall von enorm grossem Krebs in der Stirnhöhle, Oto-rhino-laryng. **11**:520 (June) 1938.

140. Asano, M.: Ueber extraorale Speicheldrüsengeschwulst der Siebbeinzellen, Oto-rhino-laryng. **11**:626 (July) 1938.

141. Bachi, S.: Carcinoma primitivo del seno sfenoidale, Valsalva **14**:390 (Aug.) 1938.

Roentgenograms revealed a shadow in the area of the sphenoid sinus with obliteration of the roof. Operation was performed under intratracheal anesthesia through a Moure incision. A compact mass was disclosed involving the posterior ethmoid region with destruction of the anterior and lateral sphenoid walls. Postoperative irradiation of the region was followed by recurrence, metastases and death. The author claims that the literature records only 40 cases of malignant tumor of the sphenoid sinus, in only 10 of which the tumor was carcinoma, the reason for this small number being that such a tumor is seldom diagnosed early enough to enable the observer to say definitely just where the point of origin is.

BENIGN TUMORS

Osteoma.—Most of the articles on osteoma the past year have been in the nature of case reports with varying features of special interest. Nothing new is offered. The most extensive work on the subject, which includes a bibliography of about 350 references, is offered by Malan,[142] who covers every phase of the topic thoroughly. He reports 5 cases of osteoma of his own affecting the frontal and ethmoid sinuses and 3 cases of exostosis or hyperostosis. He has collected the records of 458 cases from the literature and finds that in 38.95 per cent the osteoma was located in the frontal sinus, in 23.85 per cent in the ethmoid sinus and in 8.97 per cent in the antrum and the rest in adjacent bone. He divides them into four groups: eburnated, compact, spongious and mixed. As to genesis, he believes that the tumor has its origin in embryonal vestiges that are dormant for a long time but develop slowly after the cranial bones are already ossified. Trauma and infection play some part in stimulating their growth.

Hempstead's [143] osteoma was in a boy of 17. It was very dense and had to be removed *en masse*. The os planum and parts of the lacrimal nasal and superior maxillary bones were removed to gain access to it. The tumor measured 4.5 by 4 by 2.5 cm.

Ersner and Saltzman [144] reported a case because the tumor involved all of the sinuses on one side, only 2 similar cases having previously been recorded in the literature, according to the authors. Operation disclosed the mass involving the frontal, ethmoid and sphenoid sinuses and the nasal cavity and eroding the nasoantral wall into the antrum, which was almost obliterated. It was removed by mallet, gouge and electric drill. It weighed 70 Gm. and measured 6 by 4 by 1.5 cm. The

142. Malan, E.: Chirurgia degli osteomi delle cavità pneumatiche perifacciali (Contributo anatomo-clinico), Arch. ital. di chir. **48**:1, 1938.

143. Hempstead, B. E.: Osteomas of Paranasal Sinuses and the Mastoid Process: Report of Cases, J. A. M. A. **111**:1273 (Oct. 1) 1938.

144. Ersner, M. S., and Saltzman, M.: Osteoma of the Sinuses, Laryngoscope **48**:29 (Jan.) 1938.

authors recovered almost a pure culture of Staphylococcus albus, which to them was significant because of the frequent association of this germ with osteomyelitis. Since the latter process is often associated with new bone formation, they consider the possibility of the organism being the cause of the development of the tumor.

The case described by Campbell and Gottschalk [145] is interesting because of the association of the osteoma with a mucocele which was in contact with the anterior horn of the lateral ventricle, into which it had ruptured. Aside from headaches and convulsions, the man complained of sounds of "splashing" or of "water flowing" in his head, which could be heard through a stethoscope placed at either temporal region. Roentgenograms revealed the tumor extending backward from the frontal sinus and air in the lateral ventricle which moved to the region of the tumor when the patient changed the position of his head. The mass was removed through a frontal osteoplastic craniotomy. The defect in the dura was patched with temporal fascia. Recovery ensued.

Ito [146] removed an isolated osteoma durum intranasally from a girl of 17 in whom the chief complaint was recurring nasal hemorrhage. It was attached by a short pedicle to the anterior portion of the intranasal wall of the ethmoid and measured 2 by 0.81 by 0.6 cm. and weighed 3.8 Gm.

The tumor which Wildenberg [147] reports was unusually large, weighing 100 Gm., and occurred in a man of 48. It was removed in one piece without loss of spinal fluid despite its attachment to the dura over an area of a franc piece. It measured 10 by 5 cm. at its widest diameter. The author speaks of the danger of fracturing the cribriform plate and tearing the dura and advises the use of a gigli saw for isolating such a mass.

Sättler [148] quotes Belluci, who claimed that post-traumatic osteoma can be prevented by exposure to roentgen rays. No evidence has been produced anywhere in the literature to substantiate this statement. He expressed the belief that constitutional hereditary factors play the most important role in the causation of this growth. Numerous drawings from roentgenograms are produced to show the frequency of small osteomas which are discovered only by accident.

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145. Campbell, E. H., and Gottschalk, R. B.: Osteoma of Frontal Sinus and Penetration of Lateral Ventricle, with Intermittent Pneumocephalus, J. A. M. A. **111**:239 (July 16) 1938.

146. Ito, M.: Ein geheilter Fall von Osteom der Nase unter der Hauptklage von Nasenblutung, Oto-rhino-laryng. **11**:408 (May) 1938.

147. Van den Wildenberg: Ostéome fronto-ethmoïdo-maxillaire, Ann.d'oto-laryng., June 1938, p. 519.

148. Sättler, A.: Osteome der Stirnhöhlen, Ztschr. f. Hals-, Nasen- u. Ohrenh. **43**:464, 1938.

Rawlins [149] claims that osteoma of the maxillary sinus is rare, having found reports of only 29 cases in the literature, to which he adds a report of 2 of his own. One of the patients was a man of 67, the tumor being discovered accidentally in a routine roentgenogram of the sinus. There was a history of a nail having been run through the hard palate thirty-five years previously. Pus was found in both antrums. The growth was found filling the antrum and attached by a pedicle to the anterior, inferior and mesial corner of the sinus, at the point where the nail had perforated. The second patient was a girl of 19 who had had a painless swelling of the left side of her face for twelve years. Recently its growth became accelerated. The tumor extended from the palate to the floor of the orbit, causing exophthalmos, and when removed was found to consist of a dense capsule and a spongy central mass. While the tumor in the first case was well differentiated bone, that in the second was less mature, showing osteoclasts with moderate osteoblastic activity and cellular fibrous tissue in the marrow spaces.

Benjamins [150] describes an osteoid fibroma of the frontal sinus with atypical calcification in a girl of 19. He states that such a tumor grows superficially, giving rise to pseudocysts covered with tumor tissue and displacing adjacent tissues. The roentgen shadow produced resembles that of osteitis fibrosa. A typical finding is the presence at operation of a brittle tissue which on bisection shows hard granules projecting toward the surface. On microscopic section numerous hyaline bodies with some cell inclusions are found, and centrally there may be some irregular accumulations of lime embedded in a stroma of spindle-shaped cells. The hyaline bodies have the structure of osteoid substance and react similarly to stains.

In Giuffrida's case [151] an osteoma of the right ethmoid sinus extending into the frontal sinus was in association with a mucocele in the dilated frontal sinus. He feels that while mucocele in many cases may be idiopathic or primitive, in this instance it was symptomatic or secondary to obstruction of the nasofrontal duct.

Pneumatocele resulting from trauma in the presence of an osteoma has been frequently reported before. Devic, Ricard and Mansuy [152] observed this condition in a man of 40 who was an addict to alcoholic liquors. His earliest symptom was a sudden loss of consciousness in

149. Rawlins, A. G.: Osteoma of the Maxillary Sinus, Ann. Otol., Rhin. & Laryng. **47**:735 (Sept.) 1938.

150. Benjamins, C. E.: Das Osteoid-Fibrom mit atypischer Verkalkung im Sinus frontalis, Acta oto-laryng. **26**:26, 1938.

151. Giuffrida, E.: Grosso osteoma fronto-etmoidale con mucocele del seno frontale, Oto-rino-laring. ital. **8**:122 (April) 1938.

152. Devic, Ricard and Mansuy, L.: Pneumatocèle intracranienne par ostéome du sinus frontal, Lyon méd. **161**:716 (June 19) 1938.

1927 without apparent cause. In 1929 he had a fall in which the supraorbital soft tissues were split. In March 1934 he had an attack of hemiplegia, which gradually improved. In August 1934 there was again a sudden loss of consciousness, followed by headache, asthenia and reappearance of the weakness of the leg, extending to the rest of that side of the body. A roentgenogram revealed a dark cauliflower-shaped mass in the midline near the floor of the frontal sinus and a narrow clear space adjoining it. This transparent zone was shaped like a melon and extended from the posterior wall of the frontal sinus backward to the midparietal region. At operation a large mucocele was found in the left frontal sinus. The right frontal sinus was obliterated by a dense osteoma arising from the floor. The dura was exposed, and a fissure was visible in it. This was closed by a suture, and subsequently the air was absorbed. Most of the symptoms cleared up, although the patient suffered two attacks of jacksonian epilepsy within six months after the operation. It is interesting to note that the orbit was uninvolved despite the large size of the tumor.

Cyst.—Piquet and Detroy [153] report a paradental cyst in a woman of 40, which developed in the region of the first and second upper molars, became infected and ruptured through the lower eyelid as well as into the antrum, on which it subsequently encroached. It was removed through a sublabial incision. The lining of the cyst was infected, while that of the antrum was only slightly edematous.

Nakajima [154] and Sato [155] report each an instance of postoperative cyst of the cheek occurring twenty-eight and twenty-one years, respectively, after radical operation on the antrum. In the first case the patient had had no symptoms until the past year, when a swelling appeared in the cheek with slight dull pain. Aspiration yielded a clear thick yellow fluid. The mass receded and then reappeared in four months. Aspiration this time yielded a brown neutral fluid, free from mucus and cholesterol. Operation revealed the cyst situated in a dense mass of fibrous tissue filling the antrum. Its lining was a pale glistening membrane which communicated with the ethmoid cells. In Sato's case there was a history of free bleeding at the time of the original operation, but no other symptoms appeared until twenty-one years later, when the patient began having pain and swelling of the cheek. Further inquiry revealed the fact that there had been previous attacks of pain in the teeth accompanied by swelling. At operation the cyst was found to be

153. Piquet, J., and Detroy, L.: Kyste paradentaire du maxillaire supérieur fistulisé dans la paupière inférieure, Echo méd. du Nord **90**:337 (June 30) 1938.

154. Nakajima, K.: Ein Fall von postoperativer Wangenzyste (Kubo), Oto-rhino-laryng. **11**:622 (July) 1938.

155. Sato, I.: Postoperative Wangenzyste (Kubo) mit 2 Kammern., Oto-rhino-laryng. **11**:333 (April) 1938.

in communication with the antrum, which it almost filled. It contained a cloudy yellow-brown fluid, in which there were albumin and mucus but no cholesterol. Only a small portion of the lining membrane was covered by cylindric epithelium.

Gutierrez's [156] patient, a man of 32, had a small mass the size of a hazelnut in the supraorbital region for five years without symptoms and practically no change in size during that time. Roentgenograms showed that the mass was in communication with the frontal sinus. Iodized poppyseed oil 40 per cent introduced intranasally set up a reaction with pain and increased swelling. At operation it was found that the cyst, which was a dermoid, had eroded the anterior wall of the sinus but had no direct communication with the nasofrontal duct.

Mucocele-Pyocele-Pneumatocele.—The Japanese are again in the fore with reports of cases of postoperative mucocele of the antrum, which together with the frequency of their reports of cases of postoperative cyst of the cheek, leads one to suspect that there must be something in the technic or postoperative treatment in their cases which is responsible for a complication that is rarely reported in this country. Hirayama [157] observed this condition following the Caldwell-Luc operation in 2 cases, nineteen and seventeen years after operation. He attributes its development in the first case to closure of the natural ostium and in the second case to excessive granulations from the bone and soft tissues. The contents of the cavities were mucin (60 and 23 per cent) cholesterol (6 and 2 per cent) and albumin (30 and 68 per cent).

Morihana [158] did a Caldwell-Luc operation on a boy of 17 on the basis of nasal obstruction, discharge, headache, bilateral polypoid appearance of middle turbinates, pus in the middle meatuses and roentgen shadows indicating involvement of the frontal and ethmoid sinuses and antrums. The left antrum was filled with a clear thick yellow fluid giving a mucin reaction, alkaline and free from pus. Since the ostium was closed by swollen membrane, he assumes that the condition represented the beginning stage of a mucocele.

Fujii [159] reports on a man of 57 who sustained an injury to the frontal area, which was followed by exophthalmos, diplopia and swelling at

156. Gutierrez, A.: Quiste dermoideo supurado de la región frontal en comunicación con el seno frontal, Rev. de cir. de Buenos Aires **17**:120 (March) 1938.

157. Hirayama, M.: Ueber zwei Fälle von der postoperativen Kieferhöhlenmucocele, Taiwan Igakkai Zasshi **37**:1163 (July) 1938.

158. Morihana, H.: Ein Fall von Mucocele der Oberkieferhöhle, Oto-rhino-laryng. **11**:515 (June) 1938.

159. Fujii, K.: Ueber eine enorm grosse Stirnhöhlenmucocele mit ausschliesslicher Entleerung durch Punktion im Verlauf von 7 Jahren, Oto-rhino-laryng. **11**:131 (Feb.) 1938.

the internal upper orbital angle. Puncture revealed a chocolate brown mucoid material. Since the patient refused to be operated on, the mass was aspirated twenty-five times over a period of seven years for a total yield of 413 cc. Eventually a Killian operation was performed and the mass removed. The dura was found exposed over a small area, and the nasofrontal duct was blocked.

Greifenstein [160] reports on 8 patients who had cystic masses about the sinuses. Patient 1 was a boy of 15 with swelling at the internal orbital angle since the age of 3. It was removed by external operation. The paper plate, which was displaced externally, was very thin and was therefore removed to allow the bulb to resume its normal position. Hemolytic streptococci were found. Patient 2 was a woman of 65. The bulb had been displaced for one and a half years. At operation the cystic mass was found to have involved the frontal and ethmoid sinuses, whose bony walls though intact were considerably thinned out. An aerobic type of Staphylococcus albus was found. Patient 3 was a woman of 63. There were headache, loss of vision, diplopia and impairment of the mobility of the bulb. The mass involved both frontal sinuses, whose septum was gone, and had eroded the bony walls, exposing both orbits and the dura. Patient 4 was a man of 48 who had undergone a Killian operation thirty-one years ago and subsequently an injection of paraffin to overcome the deformity. For the past ten years there had been a swelling at the internal angle of the orbit, which increased in size, displacing the bulb. Operation disclosed the old bony defect involving the floor of the frontal sinus and the paper plate. The cystic cavity extended back to the sphenoid sinus and was the result of complete closure of the nasofrontal duct. Patient 5 was a woman of 52 who had had an operation on the frontal sinuses nineteen years ago. In the past two years she had complained of swelling and severe headaches. Operation revealed a large pyocele filling the ethmoid and frontal sinuses. The fluid contained gram-positive cocci. The nasofrontal duct in this patient also was completely blocked. The sixth patient (a man of 60) had no history of previous infection or operation. There were swelling, displacement of the bulb and intranasal polyps. At operation a bloody cystic mass was found occupying the expanded frontal sinus and ethmoid cells, eroding through the paper plate into the orbit. Sarcomatous degeneration was found, a diagnosis of lymphosarcoma was made, and 8,000 r was administered by the Coutard method, with recession up to the time of writing (one and a half years). Patient 7 was a girl of 12 with headaches and swelling of the right frontal area above the midline and laterally. The mass was removed by external surgical operation and was found to involve the roof of the orbit, extending upward to the dura.

160. Greifenstein, A.: Ueber Muko-, Pyo- und Pneumatozelen, Hals-, Nasen- u. Ohrenarzt (Teil 1) **29**:243 (May) 1938.

Histologic examination revealed a psammoma. The patient was symptom free for twenty-one months. Patient 8 was a man of 28 who seven years previously sustained a fall, striking his forehead with resulting commotio cerebri. Headaches, nausea and vomiting appeared two years ago, followed more recently by swelling above the supraorbital margin. Operation revealed a thin-walled cavity lined with thin mucosa, leading to a broad nasofrontal duct, which was blocked at the middle turbinate by a mucous membrane partition. The condition was bilateral, and the author terms it "pneumosinus frontalis dilatans," citing Boenninghaus as having reported 6 similar cases.

Gleichsner [161] describes in detail the history and course of a large mucocele of the frontal sinus which was in contact with the dura over a wide area. The patient, a woman of 45, gave a history of an injury to the forehead occurring twenty-one years ago. Six years later headache and slight proptosis appeared and then disappeared slowly, but reappeared ten years later. Two years later she sustained another injury in the same area which rendered her unconscious. This was followed by vomiting and aggravation of the previous symptoms. Simple incision released some dark brown fluid, with temporary improvement. An extensive frontal operation was performed later, revealing a deep cavity filled with fluid and extending behind the left eye. The dura was exposed.

Malbran and Oribe [162] report 14 cases of mucocele in the vicinity of the orbit, in 4 of which it involved the frontal sinus, in 8 the frontal and ethmoid sinuses, in 1 the anterior parts of the ethmoid labyrinth and in 1 the posterior parts of the ethmoid labyrinth. They find that trauma and closure of the nasofrontal duct are the most common etiologic factors. The symptomatic picture and the course are discussed in relation to the point of origin and the direction of growth.

Miscellaneous Growths.—Goto and Shiroiwa [163] removed a fibroma from the antrum of a man of 27. The tumor distended the cheek and nasoantral wall and presented in the mouth at the first upper left molar tooth. Symptoms had been present for only a few months. The mass was removed through a Denker operation and was found to fill the antrum and encroach on the ethmoid cells. It measured 7 by 6 cm.

Takahashi [164] reports 3 cases of a fibroma type of lesion with hemorrhagic areas. In all there was a history of repeated nasal bleeding. In

161. Gleichsner, E.: Ueber Mukozelen der Stirnhöhle, Hals-, Nasen- u. Ohrenarzt (Teil 1) **29**:213 (May) 1938.

162. Malbran, J., and Oribe, M.: Sobre mucoceles orbitarios, Arch. de oftal. de Buenos Aires **12**:575 (Sept.) 1937.

163. Goto, S., and Shiroiwa, T.: Ein Fall von Fibrom der Kieferhöhle, Oto-rhino-laryng. **11**:212 (March) 1938.

164. Takahashi, T.: Ueber die Blutgeschwulst in der Kieferhöhle, Oto-rhino-laryng. **11**:25 (Jan.) 1938.

2 of the cases the point of attachment was on the nasoantral wall near the ostium. In 1 case the tumor presented in the middle fossa.

Lust [165] discusses the dangers of operating on a tumor of the frontal sinus in the presence of suppurating sinusitis. His patient, a man of 54, succumbed to shock and sepsis. The tumor was known to be present for several years, growing from the roof of the orbit near the internal angle and causing a displacement of the bulb. It was the size of a pigeon's egg, had a fibrous capsule and eroded the roof of the orbit, exposing the dura. There was no connection with the frontal sinus. The tumor contained a colloid brownish secretion and was diagnosed as a myxofibroma.

McAuliffe [166] removed a myxochondroma from a child of 8, which seemed to arise from the anterior portion of the maxillary sinus below the attachment of the inferior turbinate. The tumor presented a swelling over the lateral aspect of the nasal bridge and was excised through a modified Denker operation. The histologic report stated that it was a "teratoid tumor developing in a fetal rest," that "elements of osteogenic sarcoma" were present and that the cells did not resemble sarcoma cells "on account of differentiation, lack of mitotic figures and absence of giant cells." The patient was being kept under observation, nevertheless, because of possible subsequent malignant degeneration.

Tsuruyama [167] removed an antral polyp measuring 9 by 3 cm. from a girl of 14 by a Denker operation. The mass originated in the antrum, grew through the fontanel and filled the nasal cavity from the anterior naris to the posterior choana. Histologically it consisted of an anterior and a posterior portion—the former was a grayish red, soft, bleeding irregular mass, which resembled a cavernous angioma, and the latter was a typical edematous polyp.

Silbernagel [168] reports the removal of a lipoma from the right antrum of a man of 50 and claims to have found only one other similar case recorded in the literature. His patient complained of typical vasomotor symptoms, and on roentgen examination with iodized oil a mass was observed outlined in the antrum; on removal it measured 1.5 by 1.5 by 2.5 cm. It had the gross appearance of fat covered by polypoid mucosa. The histologic diagnosis was lipoma.

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165. Lust: Relation d'un cas de myxome du sinus frontal compliqué de pansinusite droite, Arch. belges du serv. de santé de l'armée **91**:58 (March) 1938.

166. McAuliffe, G. W.: Myxochondroma in the Nose of a Child Eight Months Old: Report of a Case, Laryngoscope **48**:206 (March) 1938.

167. Tsuruyama, K.: Ein Fall von grossem blutendem aus der Kieferhöhle entspringendem Antrochoanalpolyp, Nagasaki Igakkai Zassi **16**:2277 (Sept.) 1938.

168. Silbernagel, C. E.: Lipoma of the Maxillary Antrum, Laryngoscope **48**:427 (June) 1938.

Castañeda and Marques [169] describe in detail the clinical course of a reticuloplasmocytoma of the frontal region in a man of 62 and discuss the histopathologic observations at length. There was a history of trauma several months previously, causing a swelling, which was diagnosed as a hematoma and incised. The tumor continued to grow and when seen by the authors presented as a mass the size of a mandarin orange, surmounted by a gaping wound, from which a fungating friable mass protruded which was a violaceous or wine red color. The skin was attached, and the tumor seemed adherent to the bone, which was shown by a roentgenogram to be partially absorbed. In addition roentgenograms revealed areas of decalcification in the temporal bone, maxilla, humerus and coccyx. The blood picture was as follows: red cells, 2,900,000; white cells, 10,000; polymorphonuclears, 60 per cent; monocytes, 30 per cent; plasmocytes, 5 per cent, and eosinophils, 2 per cent. Biopsy confirmed the diagnosis. The outcome was fatal.

Mathers and Cappell [170] report the rather rare case of a giant cell tumor of the frontal bone discovered as the first manifestation of osteitis fibrosa. The tumor was observed in a woman of 40, who complained of headache coincident with the appearance of a rapidly growing mass in the left frontal region, over a period of three months. Roentgenograms revealed a mass obliterating the sinus as well as changes in other skeletal bones. The blood calcium was high and the phosphorus low. Also there was increased calcium in the urine. Operation disclosed a soft red mass filling the sinus, eroding its posterior wall and exposing the dura. Later an adenoma of the left parathyroid was removed, following which the bony changes were arrested and normal calcification ensued. No postoperative tetany was observed. Pictures of some interesting histologic sections accompanying the article add much to its value.

SURGICAL TREATMENT

General Observations.—Skillern [171] discusses the persistence of pain following multiple operations on sinuses from the standpoint of his own experience and the responses to a questionnaire addressed to 16 experienced rhinologists. The latter elicited a wide variety of explanations, which included items such as "injury to the sympathetic nerves," "diversion of air currents," "atypical neuralgia," "synechiae," "incomplete operation" and so on. Certainly there was a lack of unanimity in the responses. The author himself believes that persisting pains are due

169. Castañeda, M., and Marques, J.: Un caso de reticulo-plasmo citoma del frontal, Rev. méd., Peruana **9**:547 (Nov.) 1937.

170. Mathers, R. P., and Cappell, D. F.: Osteoclastoma of the Frontal Bone in Hyperparathyroidism, J. Laryng. & Otol. **53**:656 (Oct.) 1938.

171. Skillern, S. R., Jr.: The Persistence of Pain Following Multiple Operations for the Cure of Sinus Disease, Pennsylvania M. J. **41**:1017 (Aug.) 1938.

to traumatism to bone and periosteum, failure to remove all diseased tissue, reinfection of previously healed cavities, injury to sympathetic nerve fibers, localized osteomyelitis or meningitis and postoperative synechiae.

Russell [172] states that the absence of pus in chronic sinusitis may not indicate a receding infection. He believes that imprisoned edema (subepithelial) is the essential lesion in the maintenance of chronic infection. This is due "to increased osmotic pressure caused by the breaking down of large colloidal molecules into small ones: this pressure can be higher than the blood pressure, being the probable cause of the death of the mucous membrane." Another cause of persisting infection is chronic osteitis. As to indications for surgical intervention, the author believes that polypoid degeneration unassociated with suppuration requires more radical surgical treatment than the simple suppurative type, which often yields to drainage and ventilation. When the antrum, ethmoid labyrinth and sphenoid sinus are all affected, he favors the Horgan operation of cavitation, in which the Caldwell-Luc procedure is amplified by removal of the entire nasoantral wall, including the middle and inferior turbinates. The ethmoid cells and sphenoid sinus are cleaned out via the antral opening. Whenever possible, the mucosa of the nasoantral wall is preserved and reflected as a flap into the antrum. Pain and postoperative swelling are marked for about a week, but the pain can be minimized by carefully suturing the periosteum in the sublabial incision. This particular operation is recommended for patients with chronic conditions previously operated on by other methods, especially patients suffering from headaches, asthma and other debilitating conditions. Commenting on the Ferris-Smith operation, the author states that he has followed 9 cases since 1935. In 2 cases there were persistent crusting and discomfort. Diplopia lasted twelve months in another. In 4 cases there were crusting, discharge, pain and retention of secretions. In 2 cases another operation had to be done because of stenosis.

Cunning's [173] experience leads him to make the following observations: The middle turbinate may be infracted as a routine in cases of acute infection for the relief of pain. Occasionally he has found it necessary to resect the anterior end of the middle turbinate. When orbital symptoms are present, he advises conservative treatment, unless bulbar mobility is impaired. In the presence of chronic cough he will operate on a sinus only if there are definite indications of pathologic alteration. He prefers to open the antrum intranasally and the ethmofrontal group by the Lynch procedure. In recent years he has operated

172. Russell, B.: The Operative Treatment of Chronic Sinus Infection, Proc. Roy. Soc. Med. **31**:226 (Jan.) 1938.

173. Cunning, D. S.: Surgical Indications in Sinusitis, Laryngoscope **48**:429 (June) 1938.

less frequently for retrobulbar neuritis than formerly, having found that the focus could be established to be elsewhere than in the sinuses.

Hill [174] found that methylene blue injected into the infraorbital canal of the cadaver was diffused through the sphenopalatine ganglion and its palatal branches. It even penetrated as far as the gasserian ganglion but did not infiltrate into the orbit. He has found in practice that injection of an anesthetic into this nerve was extremely helpful in obtaining anesthesia for intranasal ethmoidectomy and window resection of the antrum. He uses a 22 gage needle introduced directly through the skin. A few drops are injected superficially at first and then more deeply. "After a minute or so the needle is advanced into the foramen to its full length and locked in by pressure of the first and second fingers of the left hand straddling the butt of the needle. From 2 to 2.5 cm. of the solution of procaine hydrochloride is slowly injected, the operator taking five minutes to complete the injection." The procedure is sufficient also for a Caldwell-Luc operation, except for the superficial injection, along the line of incision. Also it is necessary to block the branch of the nasal nerve which comes from the ophthalmic branch of the fifth cranial nerve. This is done by injecting the anesthetic into the anterior ethmoid foramen along the nasal wall of the orbit.

Operations on the Maxillary Sinus.—von Bajkay [175] contributes a long dissertation covering every phase of surgery of the antrum. In cases of acute infection he has found it possible to cannulize the antrum through the natural opening in only 10 per cent of cases, which is quite at variance with the statistics of Van Alyea, Rosenberger and Meyerson. In cases of chronic sinusitis, if frequent irrigations by puncture over a period of four to five weeks fail to clear up the condition, he does an intranasal window operation of the Claoue-Lathrop type. In 108 of 287 such cases it was necessary at the same time to resect the middle turbinate and open the other sinuses which were simultaneously affected. Apparently the results were not all satisfactory, since it was necessary at a later date to perform a radical operation on 58 patients; in 26 of these the antral inflammation was combined with disease of other sinuses. All of these patients were cured except 2. The author prefers the Denker to the Caldwell-Luc operation when it is necessary to operate on both the antrum and the ethmoid cells because it affords an easier approach to the latter. Unless there are serious complications, he prefers leaving the frontal sinus alone, since he has observed that it frequently clears up spontaneously after the antrum and ethmoid labyrinth

174. Hill, F. T.: Local Anesthesia for Surgical Treatment of the Sinuses, Arch. Otolaryng. **27**:197 (Feb.) 1938.

175. von Bajkay, T.: Beiträge zur Chirurgie der Kieferhöhle, Hals-, Nasen- u. Ohrenarzt. (Teil 2) **47**:1 (Aug., no. 1); 49 (Aug., no. 2) 1938.

have been cleaned out. In his experience the most frequent causes of recurrence are an inadequate nasoantral fistula, incomplete removal of lining membrane and insufficient surgical work on the other sinuses.

Bettington [176] states that chronic disease of the lining of an antrum will not yield to an intranasal operation. Furthermore, it is his belief that those patients who recover following the latter procedure would in all probability get well anyway if irrigations were persistently carried out. Also he believes it is necessary to remove all of the lining, since one cannot tell macroscopically where the diseased area ends and the healthy mucosa begins. He is against the use of postoperative packing and advises as little irrigation as possible.

Discussing the radical operation on the antrum, Alden [177] offers several hints as to procedures which have proved helpful to him. He suggests examination of smears and culture of the discharge prior to operation, since a knowledge of the bacterial flora present may assist the therapy. For instance, if Vincent's organisms are present, he gives arsphenamine; if streptococci, sulfanilamide, and if staphylococci, he worries about the possibility of subsequent osteomyelitis. He finds Blair's method of blocking the second division of the trigeminal nerve effective in obtaining anesthesia. Also he prefers a triangular incision in which the vertical arm is projected upward for an inch (2.5 cm.) in the space between the lateral incision and the canine teeth.

In evaluating the worth of a procedure Millar [178] finds that a questionnaire alone is inadequate and unreliable. He prefers to draw conclusions only after examining the patient himself and studying the postoperative roentgen pictures. Of 85 patients subjected to intranasal antrostomy and examined from two to six years later, 50 per cent still showed gross swelling of the mucosa, 21 per cent moderate swelling and 13 per cent slight swelling. A large percentage also still complained of nasal discharge. The author feels that patients whose sinusitis does not yield to lavage will not recover completely unless a radical operation is performed in which the mucosa is entirely removed.

Moreaux [179] takes a more conservative stand, reporting cures in 31 of 38 patients operated on by the intranasal route. The remainder had to undergo a radical operation at a later date because of persisting symptoms. The author remarks that where the indications point definitely

176. Bettington, R. H.: Some Aspects of Maxillary Antrum Infection, M. J. Australia **1**:853 (May 14) 1938.

177. Alden, A. M.: The External Operation on the Maxillary Sinus, South. M. J. **31**:282 (March) 1938.

178. Millar, T. G.: Endonasal Antrostomy: An X-Ray Study, M. J. Australia **25**:689 (Oct. 22) 1938.

179. Moreaux, R.: Résultats de l'opération de Claoué, Oto-rhino-laryng. internat. **22**:203 (April) 1938.

to the presence of polyposis or fungoid vegetations within the sinus, or when the infection is of dental origin, or when needle puncture cannot be carried out because of the thickness of the bone, it is advisable to proceed at once to a radical operation.

Rentschler [180] claims that 49 of 64 patients were cured by the intranasal operation. He states that it is necessary to make the window large enough to permit reflection of a mucous membrane flap into the sinus. To obtain freer access to the nasoantral wall, he advises removing part of the inferior turbinate.

Grove [181] reports a case in which paralysis of the external rectus and inferior oblique muscles of the eye followed a radical operation on the antrum in which an attempt was made to enter the ethmoid labyrinth transantrally. The patient was under general anesthesia. He believes the nerves were traumatized through a defect in the floor of the orbit. An orbital hematoma resulted with exophthalmos in addition to the paralysis mentioned. The ocular symptoms disappeared only in part. Two and a half years later diplopia was still present when the patient looked in the direction of the affected rectus muscle.

Fuller [182] observed an unusual complication following a Caldwell-Luc operation in a woman of 58. The operation and immediate postoperative course were uneventful. One year later, however, there was complete atrophy of all the soft tissues of the face on the side of the operation. The nasoantral fistula was closed. In the subsequent year or so the patient gained some weight, and the face was somewhat improved. The author canvassed a number of leading rhinologists on the subject but obtained no satisfactory explanation of the phenomenon.

Figi [183] explains the methods of plastic repair of defects of the face following radical surgical operation on the antrum in cases of malignant growth as carried out at the Mayo Clinic. These reparative procedures are not undertaken until at least one year has elapsed after the healing of the primary operation. In men he uses a tubed flap from the back or the chest and in women a frontotemporal flap. The lower margin of the orbit is built up later by the insertion of a strip of bone taken from the crest of the ilium and held in place by a pin or else by a costal cartilage graft. Gingival or palatal defects are taken care of by proper

180. Rentschler, H. D.: Some Observations Concerning Chronic Maxillary Sinusitis, Pennsylvania M. J. **41**:975 (Aug.) 1938.

181. Grove, R. C.: Unusual Combination of Ocular Paralyses Following Radical Operation on the Antrum, Arch. Otolaryng. **27**:275 (March) 1938.

182. Fuller, T. E.: Unusual Complication of Radical Antrum Operation, South. M. J. **31**:1094 (Oct.) 1938; Unusual Complication Following Caldwell-Luc Operation, J. Arkansas M. Soc. **34**:94 (Oct.) 1937.

183. Figi, F. A.: Plastic Repair After Removal of Extensive Malignant Tumors of the Antrum, Arch. Otolaryng. **28**:29 (July) 1938.

prostheses. If the lip is distorted by scar contraction, it is released and an epithelial inlay employed to prevent recurrence. Photographs showing excellent cosmetic results accompany the article.

Mayer [184] has a special forceps for leveling the nasoantral wall in the intranasal operation. By means of a shaft thin enough to pass under the inferior turbinate and a spiral housing near the end it is possible to set the jaws of the forceps at an angle of 90 degrees to the shaft, which facilitates the downward biting.

Operations on the Frontal Sinus.—Lillie [185] states that the type of operation indicated depends on the lesion present and the size and shape of the sinus. In a small sinus the Jansen-Lynch type of procedure is usually sufficient. If the anterior wall is diseased, the Killian operation may be necessary. The deformity can often be minimized by beveling the bone so as to create a gradual slope into the excavated cavity. An obliterating operation is advisable for patients living some distance from a medical center or patients for whom proper after-care is not available. If it is desirable that the sinus cavity be maintained, the author suggests leaving the frontal process of the superior maxilla alone, as it prevents the collapse of the soft parts with possible obstruction of the duct. He states also that the reason some sinuses obliterate readily while others tend to remain open may be found not only in the technic employed but also in the individual reaction to repair. He prefers dry treatment in the after-care to frequent irrigations, reserving these only for occasional removal of clots. In dealing with severe acute frontal sinusitis, Lillie prefers a simple external trephine opening to any intranasal attempts at establishing drainage, a most valuable suggestion which all rhinologists may well heed.

Stone and Berger [186] offer a modification of Halle's intranasal operation in which flaps of mucoperichondrium are dissected downward from both sides of the septum just below and parallel to the nasal bridge. The septum thus exposed is removed flush with the inner aspect of the nasal bones and floor of the frontal sinus. The crista frontalis is removed by means of a burr attached to a Mueller pistol handle. The sinus is entered and the intersinus septum removed. At the conclusion of the operation the mucoperichondrial flaps are turned into the sinuses covering the denuded bone and forming a large common atrium into the nose from both sinuses.

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184. Mayer, O.: Eine Stanze für die Kieferhöhle, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **144**:309, 1938.

185. Lillie, H. I.: External Operations on the Frontal Sinus, Am. J. Surg. **42**:199 (Oct.) 1938.

186. Stone, F. E., and Berger, M.: Chronic Frontal Sinusitis: A New Endonasal Surgical Approach, Laryngoscope **48**:626 (Sept.) 1938.

Söderberg [187] reviews the history of mucous membrane flaps in frontal sinus surgery, crediting Killian with being the first to mention this point and Sourdille and Bárány with valuable contributions on the subject. The author prefers Bárány's technic, which he has modified slightly, and presents a number of excellent drawings illustrating the successive steps in the procedure. He reports on 120 patients operated on in this manner, 23 with acute and 96 with chronic sinusitis. Five patients died, 2 from acute phlegmon of the face, 1 from meningitis, 1 from osteomyelitis and 1 from septic angina. In addition there were 10 patients with other complications: 3 with lid abscess, 2 with severe nasal hemorrhage, 1 with erysipelas and 1 with angina. It is interesting to note that 20 of the patients with acute disease recovered completely and at a later date were found able to receive a 3 to 5 mm. Ritter sound; 87 with chronic disease were followed up, and all were cured but 12. Of these, 3 still had subjective symptoms; in 2 the naso-frontal duct was impassable; in 2 others it was very small, and in 7 there was a persistent mucopurulent discharge.

Kofler [188] cites a case to show that occasionally severe frontal sinusitis may be cured by endonasal surgical treatment when apparently an external operation is indicated. A man of 41 had had a chronic infection of the frontal sinus for four years. In the beginning an acute attack was relieved by intensive local treatment, and the patient had few symptoms until a year ago, when acute rhinitis precipitated a recurrence. The complaint since then was of severe morning headache, slight swelling and tenderness at the floor of the sinus, purulent discharge and crusts. The author performed a transseptal resection of the cells of the agger nasi, reaching the frontoethmoid group and through them the floor of the frontal sinus. Much creamy pus was evacuated, and with appropriate after-care the patient was completely relieved, remaining free from symptoms while under observation for a two year period.

O'Connor [189] reports 2 cases in which marked frontal deformity after extensive surgical operation for osteomyelitis was corrected by a plastic surgical procedure. In the first case a rearrangement of the skin flaps achieved a good cosmetic result and in the second a cartilage isograft was successfully employed.

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187. Söderberg, F.: Beitrag zur Kenntnis der Bárány'schen Stirnhöhlenoperation, Acta oto-laryng. **26**:541, 1938.

188. Kofler, K.: Rhinogene chronische Stirnhöhleneiterung mit paroxysmalen Stirnkopfschmerzen durch endonasale Operation geheilt, Monatschr. f. Ohrenh. **72**:990 (Oct.) 1938.

189. O'Connor, G. B.: Contour Reconstruction After External Frontal Sinus Operation, Ann. Otol., Rhin. & Laryng. **47**:183 (March) 1938.

Foster [190] used the full thickness of rib cartilage, a piece measuring 3½ inches (9 cm.) in length, to fill in a deep frontal depression following a bilateral obliterating operation. The graft was inserted through an incision at one end after tunneling under the skin all the way across to the other side.

Operations on Frontoethmoid, Ethmoid and Sphenoid Sinuses.—Bryant [191] describes the following anatomic factors which may make it difficult to maintain a patent nasofrontal passage: (1) anteroposterior deviation of the mesoethmoid portion of the nasal septum (a condition which requires a preliminary submucous resection); (2) very thin lamina papyracea and lacrimal bone which cannot be avoided in the ethmoid exenteration; (3) abnormal development of the cells of the agger nasi; (4) double frontal sinus on one side with two ostiums (these should be united); (5) naturally narrow nasal cavities and thin nose. The author considers it important always to exenterate completely the cells of the agger nasi and to remove the backward projection of the spina nasofrontalis of the superior maxilla, as first pointed out by Halle.

Lodge [192] suggests a median incision extending along the bridge of the nose and up in the midline of the frontal area, with the soft tissues and periosteum being dissected back on either side. He claims to be able thus to expose the floor of both frontal sinuses, the lacrimal areas and both laminae papyraceae, affording access to the frontal, ethmoid and maxillary sinuses.

Muskat [193] presents a general discussion of the pathologic features of involvement of the sinuses and the indications for surgical intervention with a description of the external frontoethmoid operation mainly along the lines proposed by Ferris-Smith.

Mangabeira-Albernaz [194] has done the transmaxillary ethmoid operation described by de Ermiro, of Lima, in 18 cases and is enthusiastic over it. It differs from the usual transantral operation in the fact that the nasoantral wall is resected submucously so as to avoid too large an opening into the nasal cavity with possible subsequent crusting. Also the author points out the necessity of following the cells upward to two definite points, viz., the angle formed by the lamina papyracea with the

190. Foster, B.: Extreme Disfigurement Resulting from an Operation on the Frontal Sinus, Corrected with Graft of Rib Cartilage, Australian & New Zealand J. Surg. **8**:85 (July) 1938.

191. Bryant, F. L.: The Nasofrontal Tract in the External Fronto-Ethmosphenoidectomy, Laryngoscope **47**:901 (Dec.) 1937.

192. Lodge, W. O.: Ueber beiderseitige Rhinotomie, Monatschr. f. Ohrenh. **72**:712 (July) 1938.

193. Muskat, I.: Chronic Nasal Sinus Disease, Wisconsin M. J. **37**:997 (Nov.) 1938.

194. Mangabeira-Albernaz, P.: A operação de Ermiro de Lima (etmoidectomia transmaxilar submucosa), Rev. oto-laring. de São Paulo **5**:419 (Sept.-Oct.) 1937.

inferior wall of the orbit and the angle between it and the orbital roof. The middle turbinate is left in place, which protects the cribriform plate from possible injury.

Von Bajkay [195] presents a review of various surgical procedures employed in the treatment of chronic ethmoid and sphenoid disease, omitting reference to the external approach long popularized in this country. He seems to favor the intranasal operation, which was done on 341 patients. He claims that persistence of suppuration after this operation is due to failure to remove all of the ethmoid mucosa, which in some cases is especially difficult to accomplish in the infundibular region and in the frontal cells which extend to the orbital roof.

De Gennaro [196] discusses the various approaches to the sphenoid sinus in connection with his report of the removal of a bullet. The projectile had entered the hard palate near its posterior border, perforated the soft palate and fractured the septum, the posterior end of the inferior turbinate, the outer wall and floor of the sphenoid sinus, the intersinus septum and the posterior superior wall of the sinus. The resulting symptoms were (1) diabetes insipidus due to disturbance of the parainfundibular region from basilar contusion, (2) bilateral homonymous hemianopia from contusion of the left optic tract and (3) strabismus and diplopia from paralysis of the left external oculomotor nerve branch through its close connection with the contused base. The bullet was removed by a transpalatal approach following the tract it had made. The main mass was found deeply embedded in granulation tissue in the posterior superior wall of the sphenoid sinus. A secondary plastic operation was performed on the hard palate after the acute reaction had subsided.

Proetz,[197] observing a number of patients who had undergone operations on the sphenoid sinus returning year after year because of symptoms due to closure of the enlarged ostium, came to the conclusion that the condition was due to nature's efforts to close the abnormal opening because exposure of the delicate mucosa of the sinus to inspired air caused drying with subsequent pain and crusting. He has therefore modified his procedure in cases in which operation on the sphenoid sinus is indicated, by leaving the natural ostium alone and making an adventitious opening close to the septum with a keen Sluder knife and sharp cutting forceps. He does not find it necessary to bring the opening down to the floor of the sinus, where the bone is thick, since gravity

195. von Bajkay, T.: Beiträge zur Chirurgie des Siebbeines und der Keilbeinhöhle, Acta oto-laryng. **26**:639, 1938.

196. de Gennaro, R.: Vie di accesso al seno sfenoidale (contributo clinico), Riv. di chir. **4**:71 (Feb.) 1938.

197. Proetz, A. W.: Nasal Physiology and Its Relation to the Surgery of the Accessory Nasal Sinuses, Proc. Roy. Soc. Med. **31**:1405 (Oct.) 1938.

does not contribute much to the drainage. He finds that this procedure permits adequate immediate drainage without impairing the utility of the natural ostium, which is left untouched.

NONSURGICAL THERAPY

General Observations.—Coates [198] presents a thorough analysis of the various factors, local and constitutional, contributing to sinus disease. He offers some excellent advice on the local treatment of acute conditions, embracing a description of proper methods of establishing drainage without injury to the nasal mucosa. He emphasizes the importance of capillary suction as against mass suction and points out the dangers of the latter procedure except at the stage in which the Proetz displacement procedure is indicated. He also speaks well of Jarvis' treatment with insulin and iodine and discusses the rationale and the type of cases best suited to this therapy.

Mithoefer [199] emphasizes the role of constitutional factors in the persistence of nasal symptoms and the failure of surgical treatment. Among these are hypothyroidism, intestinal stasis, hypoglycemia and allergy. He cites painful areas (supraorbital, parietal, trapezius and sternomastoid) as evidence of constitutional disturbances which should be corrected before surgical intervention is undertaken. He speaks of the four tender points of Killian which frequently need to be cauterized. For hypersecretion of mucus he advises 3 units of insulin given two or three times per week. He prefers puncture of the middle meatus with a blunt cannula to the use of a sharp trocar below the inferior turbinate. Persisting pains radiating from the orbit after a radical operation on the antrum should suggest possible "silent osteitis about the alveolus," and the patient should be referred to a dentist.

Furstenberg [200] states that sinus therapy at the University of Michigan for the past thirty years has been strictly conservative, and he quotes Canfield's caution to "avoid bone work in the presence of an acute infection." Trauma from puncture or even cannulization is avoided as well as trauma from irritating solutions, such as mercurochrome and those containing silver compounds, and from tampons. The means of treatment generally recommended are rest in bed, morphine or codeine for pain, plenty of fluids and nutritious food. Heat or cold may be employed locally, as well as steam vapor inhalations. Locally he uses

198. Coates, G. M., and Gordon, W.: Nonsurgical Treatment of Acute and Chronic Sinus Disease with Operative Indications and Contraindications, M. Clin. North America **22**:1565 (Nov.) 1938.

199. Mithoefer, W.: Pertinent Questions Relating to the Nasal Sinus Problem, J. Med. **19**:189 (June) 1938.

200. Furstenberg, A. C.: The Treatment of Acute Nasal Accessory Sinus Disease, Ann. Otol., Rhin. & Laryng. **47**:902 (Dec.) 1938.

ephedrine, 3 per cent in saline solution, by instillation or by displacement. Serious complications may follow disregarding Canfield's dictum, as evidenced by the fact that 42 of 58 consecutive patients with osteomyelitis gave a history of a preceding surgical attack made during acute sinusitis or acute exacerbation of chronic sinus disease. In 300 consecutive patients with acute sinusitis who were treated conservatively there was not a single orbital or osteomyelitic complication. These patients were hospitalized for an average of one week, five days of which were spent in bed. All patients were reexamined six months to two years later, and 296 were found asymptomatic and free from evidence of chronic sinus disease. The author advises irrigation only if the nasal discharge persists for three to six weeks after the acute attack.

Brown,[201] being located in a region where many patients are sent by their physicians for climatic relief of symptoms referred to the sinuses, is in a position to evaluate the effects of a warm, dry climate. Most of his paper is given over to a discussion of standard nonoperative procedures, as to the results of which he draws no conclusions. His inability to draw conclusions is probably due to the fact that many of the patients are transients. It would be interesting to learn, if possible, just what the long run effects would be in these patients who have been operated on repeatedly without result.

Irrigation-Suction.—Skoog [202] claims that damage may result from mass suction, although in most cases it is harmless. As a rule, negative pressure if too light fails to reach the interior of the sinus and if too strong may cause swelling of the mucosa about the ostium, with closure. Furthermore, the author has observed a submucous hematoma result from suction of the sphenoid sinus.

Andersen [203] substantiates Skoog's argument by various experiments proving that it is impossible to empty the antrum by suction, the hiatus semilunaris becoming closed off during the procedure.

Lejeune and Laoureux [204] present a detailed description of Proetz's displacement technic with the modifications introduced by LeMee. They use neoiodipin (Merck) 20 per cent, an iodized oil which is satisfactory for contrast studies and therapeutically beneficial. Among the dangers of the procedures, they mention otitis media and pansinusitis, citing 2 cases of the former with subsequent mastoiditis and 1 case of acute

201. Brown, E. H.: Conservative Management of Sinus Trouble, Southwestern Med. **22**:140 (April) 1938.

202. Skoog, T.: Some Viewpoints on Suction Treatment of Diseases of the Accessory Sinuses, Nord. med. tidskr. **16**:1045 (July 2) 1938.

203. Andersen, H. C.: Suction in Maxillary Sinusitis, Nord. med. tidskr. **16**: 1050 (July 2) 1938.

204. Lejeune-Laoureux, J.: Diagnostic et traitement médical des sinusites par la méthode de déplacement ou de Proetz, Liége méd. **31**:357 (April 3) 1938.

frontal sinusitis. Also headache, hemorrhage and the appearance of polypi were noted as a result of too much negative pressure.

Haardt [205] finds irrigations by puncture satisfactory for most chronic infections of the antrum except those due to a dental focus. The procedure is carried out every three days up to three or four weeks. If at this time the discharge still persists, the irrigations are discontinued for two weeks. In many cases the antrum seems to clear up. If it fails to do so, the cases are considered surgical, and operation is performed. For children he advises one thorough irrigation performed with the patient under general anesthesia. He has found that young adults just recovering from a cold who complain of an uncomfortable pressure or pain at the root of the nose may be completely relieved by a puncture irrigation even though no secretion is obtained.

Futch [206] has cannulized the antrum by way of the middle meatus in 1,200 cases in the past four years, constituting 72 per cent of all cases in which irrigations were done. He claims that in 40 per cent the cannulation was done through the natural ostium, and in 30 per cent, through an accessory opening. He describes the technic and reviews the work of previous authors on this subject.

Van Alyea [207] recommends irrigation of the frontal sinus for acute conditions if after forty-eight hours the temperature is normal. In subacute conditions with stuffy nose, discharge and cough, he advises a submucous resection and infraction of the middle turbinate preliminary to the irrigation, which may be repeated six to eight times. Early chronic conditions (three to eight months) require the same treatment, but the number of irrigations may have to be extended to as many as twenty. Chronic conditions of longer standing require in addition an enlarging of the natural ostium. Recurring attacks may be relieved by one irrigation but usually need surgical treatment. The author has seen no bad results from irrigation and claims on the basis of 200 specimens studied as well as clinical experience that a high percentage of ostiums can be probed for irrigation.

Watkins [208] shrinks the middle turbinate with neosynephrin hydrochloride, puts the patient in a Ritter dental chair with the head low or in the Rose position and fills the nasal cavities with a 1 per cent solution

205. Haardt, W.: Zur Spülbehandlung der Kieferhöhleneiterung, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **144**:307, 1938.

206. Futch, C. E.: Maxillary Sinus Irrigation Through the Ostia, with Anatomical and Clinical Demonstrations, California & West. Med. **48**:438 (June) 1938.

207. Van Alyea, O. E.: Study of Frontal Sinus Ostium, Ann. Otol., Rhin. & Laryng. **47**:1116 (Dec.) 1938.

208. Watkins, S.: Medical Treatment of Pyogenic Inflammation of the Nose and Nasal Accessory Sinuses, Kentucky M. J. **36**:554 (Dec.) 1938.

of sodium chloride, sodium bicarbonate and dextrose, which he allows to remain for about two minutes. The patient is then instructed to hawk the solution into the throat and sit up. Partial suction is obtained by closing one nostril at a time during the hawking process.

Gurtov [209] has a new instrument for suction-irrigation with which it is possible to irrigate both sides of the nose without making the nares airtight. This feature eliminates gagging, blockade of the eustachian tube and pain. Either side can be irrigated alone or both sides simultaneously.

Use of Drugs and Vaccines.—Coates, Davis and Gordon [210] report good results from the use of a preparation called camirol, which consists of camphor 2 per cent, menthol 4 per cent and antimony iodide 0.1 per cent. It is given subcutaneously or intramuscularly in 1 cc. ampules daily for four days and then semiweekly until improvement. In 284 cases of acute, subacute and chronic sinusitis of all types which resisted other treatment these injections were given, and very gratifying results were obtained in 32 per cent, beneficial results in 30 per cent, uncertain in 26 per cent and unsatisfactory in 2 per cent.

Calcium cevitamate (ascorbate), a calcium salt of vitamin C, is offered by Ruskin [211] as an effective remedy for acute respiratory infections and practically abortive for the common cold. Each 3 cc. ampule (15 per cent solution) contains 450 mg. of vitamin C and a calcium content of about 11 per cent. In a series of 100 cases 42 per cent were completely relieved after the first or second injection and 35 per cent markedly improved.

Fletcher [212] is a firm believer in the efficacy of argyrol tampons applied in the region of the sinus ostiums as a means of promoting drainage. He also recommends vapor inhalations carrying menthol and camphor.

Lemon [213] describes the use of Krueger's undenatured vaccine in the treatment of chronic sinusitis and cites a series of 40 cases in which this treatment was given at Temple University. These patients received an average of twenty-nine injections over a period of about four months.

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209. Gurtov, J. J.: A New Instrument for Suction-Irrigation in the Treatment of Paranasal Sinusitis, Laryngoscope **48**:286 (April) 1938.

210. Coates, G. M.; Davis, W. B., and Gordon, W.: The Parenteral Administration of Certain Substances in Upper Respiratory Infections, Ann. Otol., Rhin. & Laryng. **47**:473 (June) 1938.

211. Ruskin, S. L.: Calcium Cevitamate in the Treatment of Acute Rhinitis, Ann. Otol., Rhin. & Laryng. **47**:502 (June) 1938.

212. Fletcher, W.: The Sinuses as Points of Focal Infection and the Treatment of Sinusitis, Laryngoscope **48**:17 (Jan.) 1938.

213. Lemon, A. N.: Use of Undenatured Bacterial Antigen in Chronic Suppurative Sinusitis, Laryngoscope **48**:420 (June) 1938.

In 72 per cent satisfactory improvement was noted after other means of therapy, aside from surgical, had been tried. The initial dose given is 0.1 cc. intradermally and 0.1 cc. subcutaneously. At intervals of three to five days the latter dose is increased by 0.1 cc. each time, up to a maximum of 1 cc., after which it is repeated at weekly intervals. In addition these patients received cleansing treatment followed by the topical application of 1 to 1.5 cc. of antigen diluted with 0.5 per cent ephedrine solution, introduced by the Proetz method.

Shorell [214] uses a combination of autogenous vaccine combined with a 2 per cent solution of histadine and claims to have obtained cures in 80 per cent of his patients with chronic sinusitis. The only addition therapy employed is the local use of heat, which is applied by means of hot water circulating through a half-inch (1.3 cm.) rubber tube inserted into the nasal cavities. The temperature of the water is gradually raised from 112 to 128 F. and maintained for fifteen to twenty minutes.

Physical Therapy and Roentgen Irradiation.—Butler and Woolley [215] review their experiences with roentgen treatment of sinusitis since their first publication on this subject in 1934. They explain their good results as being due to early destruction of lymphocytes with liberation of antitoxic substances together with an early appearance of macrophages in great numbers. They claim to have proved this by histologic examination of sinus mucosa removed from experimental animals so treated. They state that this reaction accounts for the increase of discharge when the treatment is first started. They do not hold the treatment applicable to acute conditions, cysts, polypi or syphilis. Also they have found roentgen rays to have little effect on fibrotic tissue. The technical details of the treatment are given in detail. It is noteworthy that they have lately been using a higher voltage than formerly.

Hodges [216] also believes that roentgen rays in destroying lymphocytes release some vital ferment or antibody which combats infection. He advises using them to clear up acute conditions that fail to resolve spontaneously and recommends the treatment even for children. A second type of disease that has yielded good results is silent sinusitis associated with nonspecific pulmonary disease. He believes it is safe and proper to try the treatment for chronic fibrotic or polypoid changes before resorting to surgical operation, since in many instances clinical improvement has been noted.

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214. Shorell, I. D.: A New Therapy in Chronic Sinusitis, M. Rec. **148**:55 (July 20) 1938.

215. Butler, F. E., and Woolley, I. M.: The Roentgen Treatment of Chronic Sinusitis, Radiology **30**:686 (June) 1938.

216. Hodges, F. M.: Roentgen Therapy of Infections of the Nasal Accessory Sinuses, Am. J. Roentgenol. **39**:578 (April) 1938.

Smith and Nickel,[217] employing a slightly different technic from that of Butler and Woolley, report on 25 patients so treated. These are divided into three groups as follows: (1) those with the usual symptoms of sinusitis plus a large quantity of thin, watery discharge and a red, swollen, dripping mucosa presenting the appearance of acute vasomotor rhinitis; (2) those previously operated on with partial relief and persisting discharge; (3) those with heavy catarrhal postnasal drip, headache and boggy membranes. Seven patients in group 1 showed 100 per cent good results following roentgen treatment. In group 2 improvement was noted in 7 of 8 patients. The results in group 3 were less encouraging.

Popp [218] claims excellent results from roentgen treatment in both acute and chronic sinusitis. In cases of the former he gives up to 600 r in divided doses. There is a primary reaction with fever and increased discharge, which is promptly followed by rapid clearing up of all symptoms. In 10 of 18 cases of chronic sinusitis there had been resistance to all previous treatment. In 6 of these roentgen rays had cured and in 4 had greatly improved the condition. In the other 8 operation had to be resorted to. In cases of chronic sinusitis the author gives from 1,000 to 2,000 r in divided doses at intervals of two days.

Mitchell [219] reports 2 cases in which chronic sinusitis was clinically cured by roentgen rays, although the subsequent pictures failed to show any clearing of the shadow.

Troup [220] makes a plea for physical therapy in cases in which chronic sinusitis has resisted other measures, including surgical. He points out the importance of starting with small doses to avoid an unfavorable initial reaction. He finds that the ultra short wave is more likely to give rise to toxemic symptoms than infra-red radiation. Much of the paper is taken up with technical details.

In a discussion before the Royal Society of Medicine on physical therapy Zamora,[221] after explaining the action of various currents and their general uses, concludes by saying that "physical measures do not

217. Smith, H. B., and Nickel, A. C.: The Treatment of Subacute and Chronic Sinusitis by Roentgen Radiation, Am. J. Roentgenol. **39**:271 (Feb.) 1938.

218. Popp, L.: Roentgenotherapy of Sinusitis, România med. **16**:277 (Nov. 1) 1938.

219. Mitchell, H.: X-Ray Therapy in Sinusitis, M. J. Australia **2**:86 (July 16) 1938.

220. Troup, W. A.: The Treatment of Sinusitis by Radiotherapy, Brit. J. Phys. Med. **1**:158 (May) 1938.

221. Zamora, A. M.: Discussion on the Value of Physical Methods in the Treatment of Suppurative Conditions of the Nose and Throat, Proc. Roy. Soc. Med. **31**:883 (June) 1938.

materially alter the classical indications for operation and the problems of treatment remain those of mechanical drainage." Heald believes that exaggerated claims for short wave treatment have done the procedure harm. It is of value only in cases of recurrent sinusitis "when adequate drainage exists or where the chronic nature of the condition means rather that there is an inadequate blood supply to the infected lining mucous membrane." Forster wisely remarks that "the difficulty in assessing the value of treatment (short wave) lies in the fact that the majority of these cases (acute sinusitis) react well without the short wave therapy under similar circumstances." Troup in a period of nine months treated 20 patients who had undergone two or more operations without relief. He used the infra-red radiation, with relief in nearly all of them, and attributes the beneficial results to improved blood and lymph flow. Incidentally he administered a diet rich in vitamin B as well as the drug itself. Friel showed a method of entering the antrum through the inferior meatus by means of zinc electrolysis. "A puncture was made well back under the inferior turbinate by a stout zinc or brass wire or by a still rod the pointed end of which was coated with zinc. This formed the positive electrode while the negative was placed on the arm. When the current was turned on a ring of tissue around the wire was coagulated and destroyed."

Miscellaneous Observations.—Shurly,[222] while advocating the use of vitamins begun early in life as a prophylactic against sinusitis, cautions against their use to excess. He quotes Steck that hypervitaminosis D may cause intoxication and symptoms of parathyroidism.

Glas,[223] commenting on an article by Whiteman concerning the relief from tinnitus afforded by bilateral antrotomy with lavage followed by menthol inhalations, states that he has made the same observation numerous times. He noted relief from tinnitus and cure of tubal catarrh in a number of cases following his antrum operation but failed to see any connection between the two. Since Whiteman's publication he recalled an article by some Russian author quoted by Zytowitsch in which it was observed that following an antrum operation in certain cases of multiple sclerosis the mobility of the extremities was restored and in 1 case protracted tinnitus was relieved. The author attributed the phenomenon to the effects of the procaine hydrochloride block. Glas thinks that the improvement in the ventilation of the eustachian tube is the more reasonable explanation.

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222. Shurly, B. R.: Dietary Treatment of Chronic Sinusitis, Am. J. Surg. **42**:174 (Oct.) 1938.

223. Glas, E.: Neue Therapie für Schwerhörige, Wien. med. Wchnschr. **88**: 146 (Feb. 5) 1938.

Meyer [224] seems to think that infection in the teeth, tonsils and sinuses causes secondary jugular phlebitis, which he recognizes by tenderness to pressure along the vein. Having obtained good results from the use of leeches applied over the course of the vein, he argues that the treatment should benefit patients with chronic sinusitis. He believes that chronic phlebitis results in narrowing of the lumen, causing stasis and backing up of blood in the contributing veins. He applies three to five leeches over each side, and when they fall off he lets the wounds bleed for eight hours. If tenderness persists, the procedure is repeated in fourteen days. No data as to the type of sinusitis believed to be affected or the subsequent course are offered.

CLINICAL STUDIES

General Observations.—Edmunds [225] feels that the public has been led to lay too much stress on vague and irregular nose and throat symptoms and in many instances have been the victims of overtreatment. Too much emphasis has been placed on the sinuses as sources of focal infection, resulting in needless worry, often resulting in neuroses. The author believes that otolaryngologists should assist in encouraging a more rational attitude among the laity and should employ the term "sinusitis" only when sufficient local pathologic alteration is present to justify extensive treatment or surgical intervention.

Payne [226] is also conscious of a pessimistic attitude toward the sinuses, which he would like to see dispelled. He believes that unsuccessful surgical treatment may often be laid to overlooked allergic or endocrine factors.

Fox [227] considers the factors entering into sinusitis as intrinsic or extrinsic. Among the former are listed heredity, endocrine disorders, allergy, tonsillar conditions, adenoids and dietary insufficiency, and among the latter, changeable weather, dust, lack of sunshine, cold storage, poor ventilation, drafts and swimming. Common sense and careful study in each case are necessary for proper evaluation and elimination of these various factors.

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224. Meyer, O.: Latente Jugularphlebitis als Ursache von Sinusitis, Therap. d. Gegenw. **79**:333 (July) 1938.

225. Edmunds, M.: Are We Too Sinus Conscious? Virginia M. Monthly **65**:255 (May) 1938.

226. Payne, V. L.: The Modern Concept of Sinus Surgery "Versus" the Old Idea, Once a Sinus, Always a Sinus, Mississippi Doctor **15**:58 (April) 1938.

227. Fox, C. C.: Predisposing Factors and Preventive Measures in Sinusitis, Pennsylvania M. J. **41**:687 (May) 1938.

Heitger [228] gives an adequate résumé of the information the general practitioner should possess with regard to the sinuses. He rightly observes that the terms "conservative" and "radical" as applied to surgical treatment are misleading and suggests the words "complete" or "adequate."

Koebbe [229] also covers the ground in much the same manner, and both his and Heitger's papers should prove welcome to the general practitioner.

Harris [230] is impressed with the importance of a balanced diet and endocrine therapy, particularly for children. He deplores the failure in many instances to have proper roentgen studies of the sinuses made in medical cases in which a focus of infection is suspected.

Poole [231] proposes the following rules for the prevention of colds and sinusitis: 1. Don't go outdoors bareheaded. 2. Don't wet the hair and then go outdoors. 3. Protect the feet. 4. Don't sleep with the head uncovered to cold air or drafts. 5. Don't drink hard water to excess. 6. Don't sleep with the mouth open: use a "silent sleeper." 7. Don't be in a hurry: avoid fatigue. 8. Don't eat acid fruit in cold weather. 9. Avoid excessive exposure to cold.

Fawcett [232] presents a conservative outlook on sinusitis, based on a knowledge of nasal physiology, which is in line with the article just quoted and is typical of a growing appreciation of the work of Proetz, Hilding, Fenton and others.

Houser's [233] article is of a similar trend, with emphasis on the necessity of properly evaluating pain as a symptom with reference to its location, time of onset, duration, etc.

Seletz'[234] presentation follows a similar pattern. In addition he points out the influence of climate and humidity on nasal function and the possibilities of predisposing to infection.

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228. Heitger, J. D.: What the General Practitioner Should Know About the Histopathology of the Nasal Accessory Sinuses: Its Use as an Index and Guide in the Diagnosis and Management of Nasal Sinus Disease, Kentucky M. J. **36**:108 (March) 1938.

229. Koebbe, E. E.: Common Intranasal and Sinus Pathology, Nebraska M. J. **23**:24 (Jan.) 1938.

230. Harris, J. H.: The High Spots of Sinus Trouble in the Practice of Medicine, Mississippi Doctor **16**:14 (Aug.) 1938.

231. Poole, T. A.: Sinusitis, Office and Home Care, Virginia M. Monthly **65**:543 (Sept.) 1938.

232. Fawcett, K. R.: Sinusitis, Minnesota Med. **21**:112 (Feb.) 1938.

233. Houser, K. M.: Acute Sinusitis, Pennsylvania M. J. **41**:690 (May) 1938.

234. Seletz, A. A.: The Nose and Its Owner, West Virginia M. J. **34**:419 (Sept.) 1938.

White [235] calls attention to myalgic pains in the head and neck muscles, which are often assumed by the laity to indicate sinus infection. He points out the necessity for proper diagnosis in such cases.

Robison [236] is conscious of errors in treatment, particularly surgical, which are responsible for unsatisfactory end results and emphasizes the importance of differentiating between true sinus infection and allergy in order to avoid damaging true functioning nasal tissue.

A series of experimental studies on guinea pigs by Taylor and Dyrenforth [237] yielded valuable data pertaining to the harmful effects of chilling without compensation. The peripheral vasoconstriction with attendant stasis and anoxemia leads to a lowered leukocytic response and impaired phagocytic power of the resident tissue cells. Such changes predispose to infections in the upper respiratory passages.

Jowett [238] attempts to establish criteria which will enable one to offer a satisfactory prognosis. While he believes that otolaryngologists possess adequate means of determining the degree of a given pathologic process in a sinus, "it is not yet possible to give accurate prognosis or indications for a given conservative or radical method of treatment in any particular instance, as impartial observations upon results of treatment are regretfully sparse."

Daviess,[239] assistant professor of physical and health education at the University of Cincinnati, states that proper breathing will in most cases safeguard the swimmer against ear and sinus infection. She explains that inhaling through the mouth and exhaling through the mouth and nose simultaneously will avoid undue pressure of air and water such as might occur when exhaling through the nose alone. She also cautions the diver against exhaling until he has reached the surface of the water.

Von Bajkay [240] presents a review of ten years' material seen in the Budapest Rhinolaryngologic Clinic, with a statistical analysis of the cases of sinusitis. Out of a total of 56,242 patients, 13,490 underwent

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235. White, F. W.: Acute Sinus Infections, New York State J. Med. **38**:982 (July 1) 1938.

236. Robison, J. M.: Nasal Physiology and Its Relation to Sinus Surgery, Texas State J. Med. **34**:434 (Oct.) 1938.

237. Taylor, H. M., and Dyrenforth, L. Y.: Chilling of the Body Surfaces: Its Relationship to Aural and Sinus Infections, J. A. M. A. **111**:1744 (Nov. 5) 1938.

238. Jowett, R. E.: The Relationship of Sinus Infection to General Disease, M. Press **99**:78 (July 27) 1938.

239. Daviess, G. B.: Sinusitis and Ear Infections as Related to Swimming and Diving, J. Health & Phys. Educ. **9**:308 (May) 1938.

240. von Bajkay, T. V.: Bericht über das Operationsmaterial der letzten zehn Jahre und dessen interessantere Fälle an der Budapester Rhino-Laryngologischen Klinik, Monatschr. f. Ohrenh. **72**:56 (Jan.) 1938.

various operative procedures. Eighty per cent of those with acute maxillary infection were treated conservatively. In a series of 1,279 antrum punctures there were only 4 followed by complications, viz., 1 by acute otitis media, 2 by injury to the facial wall, with emphysema, and 1 by orbital infection from injury to the orbital floor. The results from their operative procedures were comparable to those of other large clinics.

Murakami [241] reports on 4 children with diphtheria of the sinuses who recovered after injection of anatoxin three times weekly for two weeks.

Role of Dental Infections.—Voss [242] attempts to show by roentgen studies and clinical histories that multiple sinusitis or pansinusitis is never the direct result of a purely dental infection. He seems to think that suppuration in the antrum accompanying a dental infection is really a pyosinus or at most a definitely localized infection that will clear up when the dental focus is removed. When pansinusitis is present, he believes the factors to be chiefly intranasal, predating the dental infection, which serves only as the exciting agent. Histologic examination in purely dental cases shows that the pathologic process in the antrum is localized to the immediate vicinity of the affected tooth, while the remainder of the mucosa is only secondarily and mildly engorged. The secretion originates in the locally diseased portion and leads to an accumulation of foul pus due to anaerobes.

Fischer [243] takes issue with Voss on this point and cites innumerable cases in which there is absolutely no history of previous sinus trouble or acute respiratory infection. Furthermore, the nasal discharge is the same foul type found about the dental socket after extraction, and treatment of the sinus empyema is fruitless unless the dental focus is eliminated; finally spontaneous cure takes place in many cases solely as a result of proper attention to the alveolus.

Shea [244] offers some practical suggestions on the care of sinus infections due to infected teeth. If the antrum has been penetrated as a result of an extraction, the procedure is thorough cleansing and watchful waiting. Should the antrum become infected, it should be treated via an intranasal opening. He again cautions dentists against the vicious

241. Murakami, M.: Erfolg des Anatoxins gegen Nasenhöhlendiphtherie und über die Immunität der Diphtherie, Oto-rhino-laryng. **11**:126 (Feb.) 1938.

242. Voss, O.: Gibt es ein dentales Kieferhöhlenempyem? Arch. f. Ohren-, Nasen- u. Kehlkopfh. **144**:113, 1937.

243. Fischer, C. H.: Gibt es ein dentales Kieferhöhlenempyem? (Eine Stellungnahme zu dem Artikel von O. Voss), Arch. f. Ohren-, Nasen- u. Kehlkopfh. **145**:82, 1938.

244. Shea, J. J.: Infections of the Paranasal Sinuses of Dental Origin, Surg., Gynec. & Obst. **66**:408 (Feb. 15) 1938.

practice of maintaining the alveolar opening for drainage. He also points out the important fact that the dentist is relieved of a legal responsibility if after extraction of a tooth the antrum is accidentally perforated, provided he immediately refers the patient to a competent rhinologist. "The patient cannot successfully sue the dentist for penetrating the antrum, but if the dentist continues to treat him, he (the dentist) may be liable for not doing what 'the state of the art' demands."

Nyman,[245] writing from the dentist's point of view, claims that in from 20 to 50 per cent of the cases antrum infection may be traced to a dental origin. Most of the antrum infections he has seen were due to "peridental infections the result of splinted teeth extensively involved with pyorrhea." He cautions against anchoring loose teeth affected with pyorrhea by means of ligatures or splints. Infection may also be carried into the antrum by means of broaches passed through the apex of a dead tooth when the root lies immediately below a thin antrum floor. Other causes of infection are forcing part of a molar root into the antrum or breaking the floor during extraction. Various measures for preventing these complications are outlined.

Lore[246] covers a wide range of conditions in which the antrum and oral cavity are interrelated and offers some practical suggestions as to management. He does not believe an adequate flap can be made for the intranasal antrostomy. He suggests using the Faulkner bob and rasp and keeping the opening patent by frequent use of sounds.

Bercher and Guillermin[247] report 2 cases of facial spasm due to dental and antral infection. The first patient, a man of 53, had spasms of the orbicularis and of the angle of the mouth for six years. Extraction of diseased upper first and third molars was followed by increase of the spasms. The antrum was found to be diseased and was eventually operated on. The spasms gradually disappeared. In the second patient, a woman of 45, there had been clonic and tonic facial spasms with nasal hydrorrhea for two years. Extraction of a diseased second molar was followed by prompt relief. The authors attribute the symptom to irritation of small branches of the sympathetic system which accompany the alveolar or pulp arteries.

Maxillary Sinusitis.—Larroude[248] presents a rather long dissertation on the pathologic changes, diagnosis and treatment of chronic maxillary

245. Nyman, J. E.: Associated Maxillary Sinus and Dental Diseases, J. Am. Dent. A. **25**:600 (April) 1938.

246. Lore, J. M.: Diseases of the Maxillary Sinus and Their Relationship to the Oral Cavity, Laryngoscope **48**:724 (Oct.) 1938.

247. Bercher, J., and Guillermin: Spasme facial d'origine dentaire et sinusienne, Rev. d'oto-neuro-opht. **16**:183 (March) 1938.

248. Larroude, C.: Les sinusites maxillaires chroniques, Ann. d'oto-laryng., February 1938, p. 113.

sinusitis with case histories and histologic sections. He attempts to divide the cases into operative and nonoperative, basing his indications on the state of the sinus mucosa as determined by studies with contrast mediums (colloidal thorium dioxide) and a determination of the emptying time according to Proetz's method. When ciliary activity has been determined to be fairly active and the sinus ostium free for drainage, if the roentgen studies show that simple hyperplasia exists, he believes the condition will yield to proper palliative treatment. He emphasizes several interesting anatomic and physiologic points, particularly those pertaining to the ostium. He calls attention to the fact that the ostium is not simply a hole but rather a canal leading from the fossette ovale into the sinus and confirms Fiol's observation that there is also a maxilloethmoid canal leading into a group of ethmoid cells. His review of the arterial, venous and lymphatic distribution is impressive, since he adds certain experimental data showing the direction of circulatory currents carrying dye substances as indicating the usual course of bacteria and the defenses of the tissues.

Finder's [249] article is a simple and satisfactory review of the diagnosis and treatment of both acute and chronic conditions and is in conformity with the usually accepted practice.

Alspach [250] prefers puncture of the inferior meatus for irrigation if acute symptoms persist beyond five to seven days and advises leaving 5 to 6 cc. of 1 per cent ephedrine in the sinus to help keep the ostium open. In subacute conditions he advises iodized oil by displacement if the usual irrigations fail to give relief.

Hall and Thomas [251] record 12 cases of spontaneous hemorrhage from the antrum. The patients were from 31 to 66 years of age. Cases of traumatic hemorrhage were not included. Ten of the patients were operated on by the transcanine route, which revealed hyperplastic changes in the mucosa. No underlying systemic disease or vascular disorder was found. The source of the bleeding was revealed in only 3 cases. The diagnosis was made from a history of recurring spontaneous nasal bleeding, the presence of fresh bleeding coming from the middle meatus, burning pain at the inner canthus and a feeling as if the bleeding were coming from the eye. Burning and itching high up in the nose were also noted. Roentgenograms showed dark antrums, and lavage revealed fresh blood and clots. Two of the patients recovered following lavage. The author comments on the absence of any mention

249. Finder: Diagnose und Therapie der Kieferhöhleneiterung, Tung-Chi med. Monatschr. **13**:173 (April) 1938.

250. Alspach, W. L.: Diagnosis and Treatment of Maxillary Sinusitis, J. Oklahoma M. A. **31**:43 (Feb.) 1938.

251. Hall, S. S., and Thomas, H. V.: Spontaneous Hemorrhage into the Maxillary Sinus, Arch. Otolaryng. **28**:371 (Sept.) 1938.

of this condition in standard textbooks and has been able to locate only two references to it in the literature of the past ten years.

Uryu [252] did a Caldwell-Luc operation on a child of 2½ years and found the antrum filled with cheesy masses, polypi and pus. There was a history of an acute swelling of the cheek six months previously, which was incised, with temporary recession of the symptoms. A fistula in the cheek persisted, which admitted a probe into the antrum. The anterior wall of the sinus was found to have been absorbed by the process. The etiologic factors were not known, although the author assumes it was spontaneous acute sinusitis.

Robbio Campos and Galante [253] report a case of spontaneous abscess of the septum occurring shortly after acute maxillary sinusitis. They believe the infection was transmitted via the lymphatics or the blood stream.

Hersh [254] reports a case of tuberculosis of the antrum in a woman of 27. The symptoms of pain and discharge led to a radical operation, which resulted in a persistant gingival fistula. A cold abscess in the loin yielded fluid which was proved to contain tubercle bacilli by culture and animal inoculation. The maxillary area remained swollen and tender, and roentgen pictures revealed bony involvement. The sinus was operated on again, and much necrotic bone, granulations and pus were removed, which on examination confirmed the diagnosis. On account of the poor condition of the patient, extensive resection was not done, although the floor of the orbit was involved. The author reviews the literature and calls attention to the poor prognosis, recovery having occurred in only 6 of 26 reported cases. The diagnosis is difficult if the disease is limited to the mucosa. Later involvement of the bone and enlargement of the glands may suggest carcinoma, and the final diagnosis will depend on biopsy and animal inoculation.

Another case of tuberculous infection of the antrum is reported by Morihana and Yamamoto.[255] It began with a swelling of the cheek and pain and was diagnosed as acute sinusitis. The sinus was opened because the symptoms persisted and were followed by severe bleeding. Examination revealed a gingival fistula leading into a cavity filled with cauliflower masses which on histologic examination proved to be tuberculoma. The patient was operated on again, and the cavity thoroughly

252. Uryu, E.: Sinusitis maxillaris caseosa im Anschluss an akute Kieferhöhlenentzündung bei einem Kinde, Oto-rhino-laryng. **11**:425 (May) 1938.

253. Robbio Campos, J., and Galante, E.: Absceso espontáneo del tabique nasal, Rev. Asoc. méd. argent. **52**:588 (June 30) 1938.

254. Hersh, J. H.: Tuberculosis of the Maxillary Sinus, Arch. Otolaryng. **28**:987 (Dec.) 1938.

255. Morihana, H., and Yamamoto, K.: Ein seltener Fall von Tuberculoma in der Kieferhöhle, Oto-rhino-laryng. **11**:341 (April) 1938.

cleaned out. In this case the diagnosis was easy because the patient had active pulmonary tuberculosis, and the Pirquet and Mantoux test were both positive.

An interesting case of foreign body within the antrum is reported by Hirayama.[256] A man of 38 while running a wood-cutting machine was struck in the cheek by a flying splinter, which he removed from the tissues himself. Three days later the cheek became swollen, and pain, tenderness and discharge appeared from the point of entry. Examination revealed a fistula at the upper end of the nasolabial fold which was lined with granulations, bled freely and admitted a probe to a depth of 5.5 cm. A Caldwell-Luc operation revealed a defect in the anterior wall of the sinus, covered partly by a fragment of bone, suppuration within the cavity and a small splinter of wood embedded in granulation tissue.

Disease of the Frontal Sinus.—A number of cases of hyperostosis frontalis interna have been reported the last year. Van Steenbergen-van der Noordaa[257] cites 6 and presents roentgen pictures showing the thickened bone in characteristic locations. He feels that although the condition is not specific, its frequent occurrence in obese women associated with excess hair and other symptoms all point to a pituitary dystrophy as the etiologic factor. Rademaker[258] encountered 5 cases, in all of which the patients were women. Psychosis, delusions, suicidal tendencies, catalepsy, mutism, headaches, weak memory and depression were among the symptoms listed. In 1 case the thickened frontal bone was surgically removed, with resulting improvement. The inner surface of the bone was covered by an irregular mass of new bone which was so adherent to the dura that the latter had to be removed with it. The arachnoid was generally thickened, the frontal convolutions flattened and the veins dilated. In 2 cases of this series the blood calcium was considerably elevated. Salzer[259] reports 4 cases, the patients being women aged 26, 27, 38 and 40 and the symptoms those already mentioned. He believes the condition is due to a disturbance of the mechanism controlling fat metabolism and calcium. In 1 case improvement followed the administration of amino-acetic acid and thyroid. Negri[260] observed the condition in a woman of 40, who presented the same dystrophic

256. Hirayama, S.: Fremdkörper in der Kieferhöhle infolge Trauma, Oto-rhino-laryng. **11**:219 (March) 1938.

257. van Steenbergen-van der Noordaa, M. C.: Six Cases of Hyperostosis Frontalis Interna, Nederl. tijdschr. v. geneesk. **82**:3751 (July 30) 1938.

258. Rademaker, G. G. J.: Internal Frontal Hyperostosis (Morgagni Syndrome), Nederl. tijdschr. v. geneesk. **82**:2245 (May 7) 1938.

259. Salzer, H. M.: The Frontal Hyperostosis Syndrome, J. Med. **19**:507 (Dec.) 1938.

260. Negri, C.: Associazione di alterazioni endocraniche e adiposi (endocraniosi iperostosica del Morgagni), Minerva med. **2**:109 (Aug. 4) 1938.

symptoms together with psychic disturbances. In this patient the metabolic rate was normal as was the blood calcium.

Lopez Villoria [261] presents in detail 3 cases of syphilis of the frontal bone. He states that the sinuses may be involved by syphilis in four different ways: (1) secondary to ulceration within the nasal cavity, (2) secondary to syphilitic osteitis of the septum or ethmoid bone, (3) congenitally and (4) primarily through the blood stream. He claims that the process usually remains localized, showing no tendency to spread through the diploetic skull bones. The diagnosis is frequently difficult, for the Wassermann test may be negative and the condition may appear like ordinary chronic sinusitis or tuberculosis.

Meksina and Khayutin [262] report 2 cases of syphilis, the first involving the ethmoid sinus and the antrum and the second the frontal sinus. In the first case there was a history of trauma to the root of the nose one week prior to the appearance of a swelling at the inner canthus and adjacent nasal bone. A solid mass the size of a nut was felt in the lacrimal region, immobile and not tender. A roentgenogram revealed a cloudy antrum and an ethmoid labyrinth with thickened bone. Puncture of the antrum gave negative results. The Wassermann, Kahn and Meinicke reactions were all positive. In the second case there was also a history of trauma preceding the swelling by one week. A smooth, firm mass was found just above the brow, and a roentgenogram revealed definite involvement of the bone. The serologic tests were all positive.

Ethmoid-Sphenoid Disease.—Kawasaki [263] did an intranasal ethmoidectomy on a woman of 39 and found the cells almost entirely obliterated by a mass of thick cheesy material. The process was found to involve the sphenoid sinus as well, and there was extensive absorption of the middle turbinate, lamina papyracea, uncinate bone and attachment of the inferior turbinate. The nasal cavity proper was blocked by polypoid masses, which evidently had interfered with drainage.

Ipolyi [264] reports an orbital abscess in a boy of 16 following an acute infection of the upper respiratory tract. Since the antrum was also infected and the septum deviated so as to block the middle meatus, he did a submucous resection, drained the antrum and attempted to open the ethmoid labyrinth. This he found to be extremely difficult because of the unusual density of the bony partitions. He explains this ivory-

261. Lopez Villoria, L.: Sifilis del frontal, Gac. méd. de Carácas **44**:179 (June 30) 1937.

262. Meksina, F. M., and Khayutin, I. M.: Traumatic Syphilis of the Nasal Sinuses and Lacrimal Sac, Zhur. ush., nos. i gorl. bolez. **15**:169, 1938.

263. Kawasaki, T.: Ein Fall von der käsigen Entzündung der Siebbeinzellen und Keilbeinhöhle, Taiwan Igakkai Zasshi **36**:2630 (Dec.) 1937.

264. Ipolyi, F.: Akute Entzündung eines infolge kongenitaler Lues eburneierten Siebbeins, Monatschr. f. Ohrenh. **72**:937 (Oct.) 1938.

like bone, as well as the absence of the frontal sinus as being the result of ethmoiditis eburnea syphilitica hereditaria. The Wassermann reaction was positive.

In a study of 137 postmortem specimens Eadie [265] found extension of the sphenoid sinus into the pterygoid process dorsolaterally and caudally on the right side in 47 and on the left in 44. Also in 52 cases (35 per cent) there were evidences of inflammation. Further investigation of a series of 89 patients by the Watson-Williams exploration suction method yielded positive cultures from 53. In most of these patients there were clinical signs of nasopharyngeal infection. The author states, however, that this method of diagnosis (by culture of aspirated fluid) is of value only when the cultures are positive, and this applies to cases in which the antrum is involved as well.

Canfield [266] presents 3 cases of sphenoiditis, with the symptoms, diagnostic procedures and therapy. In case 1 there was persisting supraorbital, infraorbital, facial, aural and occipital pains, central scotoma and contraction of the visual fields. The septum was resected, the sphenoid ostium enlarged and the sinus relieved of some thick pus. The pain subsided. In case 2 the patient had head pains, a heavy feeling behind the eyes and nasal crusting. Irrigation of both sphenoid sinuses afforded relief. After roentgen studies with iodized oil the sphenoid openings were enlarged, and permanent relief resulted. In case 3 there were periodic throbbing headaches and postnasal discharge. One sphenoid sinus was found to be full of a cheesy exudate. Relief was afforded by the operation, but the pains returned when the opening closed. The author emphasizes the importance of roentgen studies with iodized oil and the necessity of obtaining a good view of the ostium of the sphenoid sinus in making a diagnosis.

Caldwell [267] presents a discussion of the diagnosis of sphenoiditis embracing the commonly accepted procedures. He advises the use of Sluder's knives for entering the sphenoid sinus and states that the middle turbinate must be removed in about 50 per cent of the cases.

Kraus's [268] paper is a rather sketchy review of the literature covering tumors of the epipharynx affecting the base of the sphenoid sinus, tumors of the sphenoid sinus and tumors of the hypophysis. Nothing new is offered.

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265. Eadie, C. M.: Posterior Nasal Sinusitis, M. J. Australia **1**:487 (March 12) 1938.

266. Canfield, N.: The Clinical Recognition and Treatment of Chronic Sphenoiditis, Kentucky M. J. **36**:284 (July) 1938.

267. Caldwell, R.: Sphenoid Sinusitis, J. Arkansas M. Soc. **34**:163 (Jan.) 1938.

268. Kraus, L.: Ueber Erkrankungen im Keilbeinkörper und seiner Umgebung, Hals-, Nasen- u. Ohrenarzt. (Teil 2) **46**:1 (Jan.) 1938.

Disease of the Sinuses and Allergy.—Faulkner's [269] presentation deals with the practical evaluation of pathologic factors found in conjunction with allergic manifestations. In general he favors giving the case over to the allergist when gross pathologic alteration is not readily demonstrated or when the symptoms are predominantly allergic. However, one must not rely entirely on attempts at desensitization, since in many cases the disease will fail to yield until attention is paid to relieving pressure from local hypertrophies. The discovery of polypi should always lead to a thorough study of the sinuses. The cytologic examination is of value here in deciding for or against surgical treatment. The author recalls many cases in which the polypi appeared to be entirely on an allergic basis, yet the history of a previous acute infection and the predominance of symptoms on one side pointed to infection, and subsequent operation justified the diagnosis. He calls attention to headaches of the "morning after" type which are due to hyperplasia within the ethmoid cells and sphenoid sinus without extrusion of polypi into the meatuses. Properly interpreted roentgen pictures should demonstrate this condition clearly.

Kern and Schenck [270] are definitely of the opinion that polypi are in every instance an evidence of an allergic basis and make the statement that "avoidance of, or desensitization with, allergens yields clinical results far superior to the old routine of surgical removal alone with its distressingly frequent recurrence of the polyps." They advise against any surgical treatment during the pollinating season and advise removal of polyps only when they are obstructive. Their entire emphasis is on the allergic side of the question, minimizing the question of coincident infection and the necessity for surgical intervention.

Opheim [271] makes a thorough analysis of a large number of cases on the basis of symptoms, operative findings, histologic sections and phenomena of allergy and concludes that 25 per cent of all cases may be included under the designation of "rhinosinusitis chronica hyperplastica allergica". These cases are characterized by catarrhal symptoms, nasal obstruction, frequent colds. Roentgen studies and cytologic examination are important in diagnosis. The author advises surgical operation only for major anatomic defects and states that he has had good results from the use of nonspecific desensitization, recommending "novoprotin" (a plant albumin) as a particularly useful agent.

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269. Faulkner, E. R.: Problems in Diagnosis and Treatment of Hyperplastic Sinusitis and Allergy, Ann. Otol., Rhin. & Laryng. **47**:144 (March) 1938.

270. Kern, R. A., and Schenck, H. P.: The Diagnosis and Treatment of Mucous Nasal Polyps, with a Consideration of the Allergic Factor, M. Clin. North America **22**:1633 (Nov.) 1938.

271. Opheim, O. F.: Allergic Diseases of Nose and Sinuses, Nord. med. tidskr. **16**:1607 (Oct. 15) 1938.

Black [272] reports in detail a case which illustrates the difficulties of differentiating between chronic sinusitis and perennial hay fever. Despite positive roentgen evidence of thickened mucosa, more reliance is placed on the pale mucosa, the watery discharge and the increase in eosinophils. If in addition there are positive skin reactions, there can be no doubt of the predominant role of allergy in the case, and surgical treatment should be restricted to removal of gross obstructions. The author suggests the oral administration of ephedrine or benzedrine in preference to their local application.

Fractures.—Fehr [273] made a study of 417 patients with basal skull fractures treated at the Zurich Clinic during the past seventeen years. In 20 (4.8 per cent) meningitis developed from fractures in the vicinity of the sinuses. In 18 of these the meningitis appeared early and in 16 ended fatally on an average of seven days after the accident. The statistics show that meningitis is three times as frequent with fractures involving the sinuses as with fractures affecting the petrous bone. The course is usually stormy, leading to early death, especially if the cribriform plate or the ethmoid labyrinth is involved. The author advises against routine operations on skull fractures involving the sinuses because experience shows that most of the patients get well. If, however, symptoms of meningitis appear there should be no delay in widely exploring the sinus area in contact with the brain.

Laskiewicz [274] presents an extensive discussion of fractures and foreign bodies of the sinuses and reports 10 cases. The treatment depends on the nature and extent of the involvement. Simple fractures involving the walls of a sinus may be treated conservatively. In the presence of complications, such as displacement of fragments, hemorrhage or injury to the dura, the indication is to do an external operation. It is important to distinguish between a simple fracture and one complicated by an infection. Conservative treatment is directed toward the prevention of the latter. At the same time the author advises operation when there is displacement of a fragment of bone from the anterior or posterior wall of the frontal bone, the anterior wall of the antrum or the ethmoid bone. The exposure should be wide enough to permit adequate inspection of the affected area, so that foreign bodies and bone fragments may be removed and open drainage instituted. Seven cases of foreign body are reported as follows: (1) A portion of a bullet

272. Black, J. H.: Perennial Hayfever Diagnosed as Chronic Sinusitis, Internat. Clin. **1**:266 (March) 1938.

273. Fehr, A.: Zur Behandlung von Schädelbasisbrüchen bei Komplikationen von Seiten der Nasennebenhöhlen und des Ohres, Helvet. med. acta **19**:637 (Nov.) 1937.

274. Laskiewicz, A.: Considérations sur le traumatisme des sinus et leurs corps étrangers, Rev. de laryng. **58**:937 (Nov.) 1937.

was extracted from the ethmoid sinus through an external operation; (2) a bullet and fragments of bone were removed from an antrum by way of a Caldwell-Luc opening; (3) a gutta percha plug that had been forced into the antrum from an aveolar fistula was removed through a Caldwell-Luc opening; (4), a fragment of shrapnel was removed from the antrum by a Caldwell-Luc opening; (5) a shell fragment was observed in the antrum, but operation was refused; (6) the root of the first molar was in the antrum and was removed through a canine fossa approach; (7) a rhinolith of the inferior meatus was eroding into the antrum.

Killian [275] reports a case of depressed fracture of the frontal sinus in a man of 25, with extension into the base. The patient was brought to the clinic four weeks later with impaired vision, tender frontal area and depressed nasal bridge. Roentgen findings indicated a fracture through the frontal bone extending into the orbit and an accumulation of air posterior to the frontal bone. In addition rhinorrhea was noted. At operation a depressed fragment was removed, and the entire frontal bone was found pushed backward, its posterior wall splintered and the dura torn. Light adhesions were already present. The cavity was packed and left open. Later roentgen examination showed the pneumatocele increasing in size. The rhinorrhea was also continuous, and a new symptom appeared, namely, paresis of the superior oblique ocular muscle. The fundus was normal. A second operation was performed to close the fistula. Eventually the rhinorrhea ceased, the air disappeared, and the fractures healed. Analysis of 110 cases from the literature shows that 37 of the patients recovered under conservative treatment and 37 after operation, while 8 died under conservative treatment and 20 after surgical intervention. Examination of the fatal cases reveals the following complications: pneumatocele from gunshot wounds in 17 per cent; pneumatocele from gas bacillus in 50 per cent; pneumatocele from frontal fracture in 22 per cent; pneumatocele from basal fracture in 30 per cent, and pneumatocele from tumors in 33 per cent. The high percentage of recoveries under conservative treatment proves the value of waiting. This also accounts for the higher mortality among the patients operated on, since surgical operation was resorted to only when complications arose. Of 59 patients with traumatic pneumatocele, 46 recovered. Eight of the 10 deaths in this group followed surgical intervention. On the other hand, 10 patients who were operated on to relieve pressure on the brain all recovered.

275. Killian, H.: Pneumatocele des Stirnhirns nach Trauma, Zentralbl. f. Chir. **65**:1186 (May 21) 1938.

Fenster's [276] case was that of a man of 33 who fell 8.5 meters on his head, sustaining a fracture which rendered him unconscious. Roentgen examination showed a linear fracture of the right frontal bone into the orbit and air in the left lateral ventricle and the third ventricle. Later pictures showed air in the posterior horn of the lateral ventricle, the subarachnoid space and the fossa rhomboidea. Also the fracture line was seen to extend through the lamina papyracea. The author assumes that the air entered the fracture line in the ethmoid region, passed to the cranial base, from here over the subarachnoid space and because of the prolonged low position of the head finally entered the foramen magnum and extended thence to the ventricular system. He believes that the low position of the head definitely predisposes the patient to the entrance of air within the cranial cavity in cases of this type.

Miscellaneous Studies.—Cullom [277] believes that sinus infection is a frequent cause of suppurative otitis media and favors surgical treatment of the focus. Should the sinusitis exist in the presence of mastoiditis, he advises operating on the mastoid first and taking care of the sinus as soon after as feasible. According to the author, purulent otitis media and mastoiditis are the result of suppuration from a sinus in at least 85 per cent of the cases. A number of instances are cited in illustration.

Mazza and Olle [278] contribute a paper which was part of a symposium on trypanosomiasis following an epidemic of the disease in the Argentine Republic. They report 5 cases in which this disease simulated acute sinusitis; most of the patients were children. They showed rapid onset of illness, with edema of the face, lids and forehead, leading to a mistaken diagnosis of acute frontal or ethmoid sinusitis. A correct diagnosis was made on recovery of the parasites from the blood stream and finding of the typical blood picture, viz., decrease in polymorphonuclears and increase in lymphocytes, monocytes and eosinophils. In addition the following symptoms were present: rapid pulse, enlargement of the spleen and lymphatic glands.

Bouchet and Bourdial [279] attempt to define a new clinical entity in which serous rhinorrhea is associated with a definite pathologic condition of one or more sinuses. The condition is due either to a renal disturbance or to colloidoclastic shocks producing vasomotor crises at

276. Fenster, E.: Stirnbeinfraktur mit Luftansammlung im Schädelinnern, Röntgenpraxis **10**:101 (Feb.) 1938.

277. Cullom, M. M.: Chronic Middle Ear and Mastoid Infection, J. Tennessee M. A. **31**:11 (Jan.) 1938.

278. Mazza, S., and Olle, R.: Observaciones de formas agudas benignas de enfermedad de Chagas, una de ellas considerada sinusitis frontal, en Santiago del Estero, Invest. enferm. de Chagas, 1938, no. 39, p. 22.

279. Bouchet, M., and Bourdial: Les sinusites sérouses, Paris méd. **2**:158 (Sept. 3) 1938.

intervals. He believes that the disease of the mucosa of the sinuses is the inciting cause. Symptomatically it is characterized by crises of severe coryza with profuse watery discharge and evidence of unilateral sinus involvement. Roentgen examination with use of iodized oil will usually demonstrate the seat of the pathologic changes. Puncture and aspiration reveal a flocculent, fibrinous, shreddy discharge. The clinical investigation should determine whether the sinusitis is the primary cause or whether it is secondary to the constitutional condition which the author terms the *colloido-clasique diathèse,* exudative or allergic. As for therapy, if the patient is definitely allergic, the treatment must be conservative. Otherwise the author advises puncture and lavage and, if necessary, a nasoantral window operation. He has found a careful dietary regimen of value for both types of patient.

Schütz [280] reports 8 cases of malignant granuloma of the nose and sinuses observed in the Charité clinic over a period of years. Six of the patients died. One is still living but not cured. One is definitely cured. In most of the cases the disease lasted from three to twenty-four months. In the patient who recovered spontaneously an ulceration of the lateral nasal wall, middle turbinate and septum had already developed. In all the other cases roentgen rays, radium, surgical and other measures were tried without result. Autopsies in 4 cases failed to help in the diagnosis. Bacterial studies were inconclusive and animal inoculations without result. Histologic studies showed marked granulation tissue, infiltration with round cells and here and there large pale round cells, occasional mitosis and typical vascular reaction. The difficulty in diagnosis arises from inability to say whether the round cells are of inflammatory origin or true tumor cells, and this is what makes the only diagnosis possible, namely, "granuloma malignum." A zone of necrosis is also frequently found on which the author comments as follows: "Without apparent cause a progressive breaking down of cellular structure takes place with very little exudation from the blood vessels: nothing in the granulation tissue speaks for a change by which the necrosis could be termed primary." The blood usually showed slight leukopenia, which helps differentiate the condition from lymphosarcoma. Also there is a shift to the left with large numbers of band cells. The picture is similar to that of typhus or paratyphus. At the height of these diseases lymphocytosis appears in those cases in which improvement is shown. Such a change was observed in a case of morbus Bang in which there was a beginning malignant granuloma of the antrum which healed. This similarity suggests the possibility of an infectious origin of the disease.

25 East Washington Street.

280. Schütz, W.: Verschiedene Formen von Gangrän der Nase und Nasennebenhöhlen, Ztschr. f. Hals-, Nasen- u. Ohrenh. **44**:244, 1938.

Abstracts from Current Literature

Ear

PATHOLOGY OF MÉNIÈRE'S SYNDROME. C. E. HALLPIKE and H. CAIRNS, J. Laryng. & Otol. **53**:625 (Oct.) 1938.

Hallpike and Cairns describe the microscopic changes in the temporal bones of 2 patients with Ménière's syndrome. In each of these the affected temporal bone showed gross distention of the endolymphatic system, together with degenerative changes in the sensory elements. A possible explanation of this distention is suggested by the absence in both patients of the normal area of connective tissue around the saccus endolymphaticus.

J. A. M. A.

THE INDICATIONS FOR OPERATION IN MASTOIDITIS. MAX BERGER, Rev. de laryng. **59**:418 (May); 582 (June); 656 (July-Aug.); 779 (Sept.-Oct.); 867 (Nov.) 1938.

This is actually a monograph of one hundred and sixty pages published serially in five succeeding issues of the *Revue*. There is a bibliography of forty-three pages, which begins with the year 1880 and carries one reference for 1938. There are eighteen line diagrams. The author considers normal anatomy, pathologic anatomy, clinical (including roentgen) findings and operative findings. The work is divided into five sections as follows: anatomy, pathologic anatomy, clinical types, indications for operation and conclusions. The monograph is based on the cases studied in Potmann's clinic and already summarized in the thesis of Cheris-Hamade. Five hundred and eighty-six cases were analyzed. The discussion of anatomy is on the whole satisfactory, although it tends to be more architectural than developmental. Particularly glaring is the omission of the work of Körner on the developmental cell tracts in the temporal bone. This is especially surprising considering the prominence that the author gives to the petrosquamosal suture and the accurate depiction of its relation in the diagrams. (The reviewer differs with the author's account of the differences between the infant and the adult position of the mastoid antrum.) The author, however, does not revert to the early description, which is still common in many accounts. The discussion of pathologic anatomy follows fairly classic lines. Here again the description of the extension to the various parts of the temporal bone and into the surrounding tissues follows a more or less architectural pattern, and the author does not consider the anatomic tissues involved. Little or no mention is made of the role of the venous system in the propagation of infection into the various parts of the temporal bone and into the surrounding tissue. The author observes that eburnated bone alone resists infection and that, whether the bone is pneumatic or diploetic, infection will spread through it under proper circumstances. He declares himself against the concept of primary mastoiditis and prefers to call the condition in the cases pseudoprimary, feeling that careful questioning of the patient and a careful clinical examination will develop the essential character of a disease spreading from the middle ear or secondary to some systemic infection. As to the invading organism, the author seems to feel that Streptococcus or Streptococcus mucosus is the common infecting organism and that no further thought need be spent on this subject. (While in few American clinics culture of the material obtained by paracentesis is made as a routine, there seems to be a general feeling that the practice of otology would be definitely improved by this procedure.) Particular attention is paid to mastoiditis in the aged; the author states that the heavier bone in the aged is a confusing finding and leads to the overlooking in many cases of mastoiditis in the early stages. The discussion of the clinical diagnosis minimizes the importance of the roentgen findings. The author feels that they are so variable that but little

dependence can be placed on them. (This again is rather contrary to the accepted American opinion that the roentgen findings, while not sufficient to furnish indication for operation, should always be considered in determining on opening the mastoid process.) Three procedures practically unheard of in America are discussed as useful in diagnosis. One is the percussion technic of Masini. Percussion of a diseased mastoid process gives a dull note in comparison to the normal sound. This is more apparent to the patient than to the examining physician. In the auscultation procedure of Miodonski two Toynbee diagnostic tubes are used. With a low-pitched tuning fork, similar areas are compared on the two sides of the head. The transmission by bone conduction is much accentuated on the diseased side, and the statement is made that by careful work it is almost possible to limit exactly the extent of the disease. The third unusual procedure is the caloric procedure of Zalewski, which has one or two modifications. In its primary form, the mastoid areas are cooled with Leiter coils, and the rate in the drop of temperature in the external auditory canal is noted. The fall in temperature is less on the diseased side. In concluding, the author speaks strongly in favor of surgical intervention to prevent complications and decries indecision when both the clinical signs and the prognosis are grave.

BATSON, Philadelphia.

BONE CONDUCTION. G. G. KOULIKOVSKY, Rev. de laryng. **59**:521 (June) 1938.

These studies, from Prof. V. I. Voyatchek's laboratory in Leningrad, Russia, are reported in considerable detail. Bone conduction was studied in living animals and human beings and on the dry skull. A sound-proof room and the necessary modern electrical equipment were available. The animal was studied by the method of Wever and Bray. The dried skull was investigated by the usual method of using a "driver" attached directly to the skull and a "pick-up" which could be moved. In the human being, microphones placed over the auricle picked up the vibrations produced by a tuning fork held against the head. Investigators will no doubt familiarize themselves with this work in the original article. The conclusion that under controlled conditions in a sound-proof room there is no evidence of prolonged bone conduction is of general interest. BATSON, Philadelphia.

ZYGOMATIC MASTOIDITIS. PIQUET and DEROSNE, Rev. de laryng. **59**:817 (Nov.) 1938.

The authors report observations in 17 cases. Zygomatic mastoiditis is characterized essentially by a tendency to exteriorization in the temporal fossae. Edema of the soft tissues is marked, and the abscesses frequently are large. The localization corresponds to the supra-antral extension of the mastoid cells. Anatomically, there is always excessive development of the pneumatic cells in this area. Almost always there is a deep temporal abscess between the muscle and the bone. With the pneumococcus or the streptococcus as the infecting agent, there may be no abscess but only edema. Zygomatic mastoiditis is particularly common in the young infant, although it occurs also in the adult. Ordinarily it is seen as a primary clinical state, following shortly after suppuration of the middle ear. The clinical findings are signs of localization at the surface. The elevation of temperature is insignificant, and there is little disturbance of the general health. The development is rapid. Trismus is exceptional. The abscess may localize in the mastoid area. The authors feel that surgical intervention must be carried out early. Extensive mastoidectomy must be performed. BATSON, Philadelphia.

OTOGENOUS ENCEPHALITIS PURULENTA PROGRESSIVA. HANS BRUNER and ROBERT DINOLT, Ztschr. f. d. ges. Neurol. u. Psychiat. **162**:106 (March) 1938.

Bruner and Dinolt report 2 cases of diffuse hemorrhagic purulent encephalitis following infection of the ear. The patients were men aged 44 and 34. In

both cases the disease followed an acute exacerbation of chronic otitis media. In the first case there was extension of the infection from a thrombosed sinus to the occipital lobe, and in the other, direct extension from the infected ear along the pial vessels into the contiguous temporal lobe. In neither case was an abscess observed at necropsy, though in the first case the duration of the illness was ten and in the second twenty-three days. Focal signs of involvement were present. In both instances a clinical diagnosis of abscess of the brain was made, though exploration gave negative results. The authors suggest the term otogenous encephalitis phlegmonosa for this condition, especially because of the rapid spread of the purulent infection. Microscopic examination showed considerable polymorphonuclear infiltration but no abscess formation which could be treated surgically.

SAVITSKY, New York. [ARCH. NEUROL. & PSYCHIAT.]

THE REPORT OF A STUDY OF OCCUPATIONAL DEAFNESS. STEINBERG, Ztschr. f. Hals-, Nasen- u. Ohrenh. **44**:310, 1938.

The author has made a study of occupational deafness in persons with a number of occupations, such as metal workers and operators of air pressure hammers. While these patients were blaming their occupation for their increase in deafness, the author's study failed to establish this factor as a direct cause. However, he believes that when deafness or some underlying constitutional disease exists, the occupation may act as a secondary factor.

PERSKY, Philadelphia.

SEQUESTRATING PERIOSTITIS AS A CAUSE OF CHOLESTEATOMA OF THE EXTERNAL AUDITORY CANAL. OTTO MAYER, Ztschr. f. Hals-, Nasen- u. Ohrenh. **44**:337, 1938.

The author cites 4 cases of cholesteatoma of the external canal. The tympanic membrane was intact in each case. He believes that the causative factor was periostitis of the canal and does not believe that the condition was purely an evidence of an epidermal plug. With an epidermal plug, he believes, there is usually a disproportion between the rate of formation of the epidermal tissue, its desquamation and its expulsion from the canal. This is not shown by the microscopic study in his cases. He suggests that there may be a syphilitic basis for the cholesteatoma.

PERSKY, Philadelphia.

THE CLINICAL CONSIDERATION OF CHOLESTEATOMA OF THE MIDDLE EAR AND ITS COMPLICATIONS. HELMUTH RICHTER, Ztschr. f. Hals-, Nasen- u. Ohrenh. **44**:340, 1938.

The author reports a series of 136 cases of cholesteatoma of the middle ear in patients varying in age from 1 year to 68, three quarters of them belonging in the first three decades.

In 13 cases the cholesteatoma was bilateral. The author performed 143 operations in all, 87 on the right ear and 56 on the left, but he did not attach any particular significance to the incidence on either side. Eighty-one patients were studied roentgenologically; of these, 80 showed marked limitation of pneumatization. He had 123 recoveries and 14 deaths (10 per cent).

He had an impressive series of complications (110 cases): subperiosteal abscess in 9 cases, extradural abscess in 11, perisinal abscess in 25, labyrinthitis in 27, thrombosis of the lateral sinus in 13, cerebral abscess in 4, abscess of the temporal lobe in 4 and suppurative meningitis in 17. Those in 65 were dangerous. Analysis of 62 of these 65 cases showed 48 recoveries (77 per cent) and 14 deaths (23 per cent). The organism most frequently found was Bacillus proteus (37 cases); next in frequency were the hemolytic streptococcus, Staphylococcus aureus and Staphylococcus albus; the other usual organisms were less frequent. The spinal fluid, studied in 13 cases of meningitis, was sterile in 4.

In summarizing, the author discusses the question of 14 deaths and stresses both the importance and the danger of cholesteatoma as indicated by this long list of complications. He finally urges that an early operation be undertaken whenever cholesteatoma is suspected.

PERSKY, Philadelphia.

Pharynx

PROGNOSIS IN CASES OF TUBERCULOSIS OF THE TONSILS, ADENOIDS AND CERVICAL LYMPH NODES: A STUDY OF PATIENTS FOLLOWED FOR ELEVEN TO TWENTY-THREE YEARS. J. BORDLEY III and J. W. BAYLOR, Bull. Johns Hopkins Hosp. **63**:132 (Sept.) 1938.

Seventy-nine patients who at operation between 1912 and 1924 were discovered to have tuberculosis of the tonsils or adenoids were subjected to reinvestigation in 1935. Of 47 patients operated on prior to the age of 14, 45 could be traced; 2 of these had died of nontuberculous diseases, and 1, of tuberculous meningitis several months after operation. All the 42 living patients were well. The 2 patients who could not be traced were well when last seen, from fifteen to twenty-two months after operation. In this group the incidence of serious tuberculous sequelae was low, and no patient showed any evidence of having acquired pulmonary tuberculosis of the adult type since the operation. The high incidence of tuberculous cervical adenitis and the complete absence of progressive pulmonary tuberculosis among these patients constitute an interesting observation in view of the controversy concerning the prognosis of this form of tuberculosis.

LYTTLE, New York. [AM. J. DIS. CHILD.]

CERVICAL ADENOPATHY DISCLOSING A PHARYNGEAL EPITHELIOMA IN A BOY OF NINE YEARS. M. CONDAT, J. GADRAT and J. LASSERRE, Arch. de méd. d. enf. **41**:563 (Sept.) 1938.

Neoplastic adenopathies, frequent enough in adults, are extremely rare in children. The writers report a case of voluminous cervical adenopathy which for several months was the sole manifestation of latent epithelioma of the pharynx. Cervical adenitis followed an attack of measles; the origin was at first considered tuberculous, and the boy was subjected to radiotherapy, without visible improvement. When he entered the hospital a painless mass was noted occupying the entire lateral aspect of the right cervical region; the skin was not adherent. On the left side three small nodules were present along the course of the jugular vein, but no further ganglionic area was involved. Examination of the posterior pharyngeal wall revealed a tumefaction, particularly noticeable toward the right. Histologic investigation following removal of one of the small glands of the left cervical region and of tissue from the pharyngeal tumor showed identical evidence of a basocellular epithelioma, springing primarily from the mucosa of the pharynx.

The evolution of the neoplasm was rapid; the boy became dyspneic, and a fatal hemorrhage terminated life seven months after the cervical adenopathy was first noted.

AMESSE, Denver. [AM. J. DIS. CHILD.]

FATAL SPONTANEOUS HEMORRHAGE FROM A TONSIL. E. SCHLITTLER, Pract. oto-rhino-laryng. **2**:19 (Feb.) 1939.

The author reports a case of spontaneous hemorrhage from one tonsil, apparently due to erosion by phlegmonous necrotic inflammation.

The patient, in spite of this condition, did not show any evidence of generalized infection or toxemia. Microscopic examination of the tonsillar bed showed extreme alteration of the smaller blood vessels within the necrotic area, but the author was not able to see any evidence of erosion of the larger arteries or veins.

PERSKY, Philadelphia.

Nose

RHINOSPORIDIOSIS IN UNITED STATES. G. T. CALDWELL and J. D. ROBERTS, J. A. M. A. **110**:1641 (May 14) 1938.

Caldwell and Roberts report the case of a white boy aged 16 who complained of nosebleed for three months. A small polypoid mass attached to the right side of the nasal septum had first been noticed two months previously. Histologic study of the lesion revealed edematous vascular fibrous tissue in which were scattered many spherical encapsulated cystlike structures varying in diameter from 40 to 300 microns. These were considered to represent various stages in the development of Rhinosporidium seeberi. Only 6 previous cases in the United States have been reported. LEWIS, New York. [ARCH. DERMAT. & SYPH.]

PARANASAL SINUS DISEASE IN CHILDREN. S. Z. FAIER, Nebraska M. J. **23**:370 (Oct.) 1938.

It is reasonable to suppose that diseases of the nasal sinuses are not rare in children, though they are often overlooked. Such factors as deficiencies in the diet, allergy and other abnormal conditions, such as local obstructions, are worthy of attention. The ethmoidal cells are always present at birth, and the maxillary sinuses are only rarely absent. The presence of swollen membranes about the ostium of a sinus, foreign bodies, tumors or anything else that causes stagnation always results in infection. Roentgen examination should be made early rather than late. If there is malnutrition, chronic arthritis, chronic bronchitis, bronchiectasis or other systemic infection, tonsillectomy and adenoidectomy often improve the child's general condition. Listlessness, poor appetite, underweight and anemia suggest the possibility of chronic sinal infection. In acute involvement of the sinuses the predominant symptoms are nasal stoppage or a feeling of fulness in the head with nasal discharge; pain and headache may be brought about by closed empyema. In older children a small mirror can be used for postnasal examination. Smears may reveal either a large number of pus cells or a predominance of eosinophils, indicating allergy. Swelling of the eyelids and cheeks, tenderness of the involved sinus and enlargement of the postcervical glands are often present. Cooperation between the otolaryngologist and the pediatrician is necessary. In a great percentage of the cases of sinal infection operation for the removal of obstructions is sufficient. The aim of treatment is to obtain ventilation and drainage by the simplest method possible. In a large percentage of cases chronic sinal infection in a child clears with removal of the tonsils and adenoids.

HAMILTON, Omaha. [AM. J. DIS. CHILD.]

VARIOUS TYPES OF GANGRENE OF THE NOSE AND NASAL SINUSES. WALTER SCHUTZ, Ztschr. f. Hals-, Nasen- u. Ohrenh. **44**:244, 1938.

The author cites 8 cases of malignant granuloma of the nose and sinuses. There were 6 deaths and 2 recoveries. Two of the patients who died had complicating lymphosarcoma with terminal metastasis. The other 4 died of meningeal complications.

He discusses the various types of granuloma in his series, establishing a diagnosis by both biopsy and examinations of the blood. While the pathologic changes had been localized in a few cases to the nose and sinuses, they were often part and parcel of the generalized infective process. PERSKY, Philadelphia.

SINUSITIS AS A CAUSE OF DISEASE OF THE UVEAL TRACT. JOSEF JASCHEK, Ztschr. f. Hals-, Nasen- u. Ohrenh. **44**:264, 1938.

The author cites 4 cases of ocular complications relieved by surgical treatment of a sinus. The complication occurred in 3 cases on the same side as the affected

sinus. There were 3 Caldwell-Luc operations, 1 with ethmoidectomy, and 1 ethmoidectomy alone.

The author states that it was difficult to establish the relation between the pathologic changes of the eye and those of sinuses; while there may be an anatomic relation between the two structures, he is of the opinion that there may have been an infection with a virus that is specific for the uveal tract. He stresses the role of focal infection in the case of contralateral involvement.

PERSKY, Philadelphia.

CEREBROSPINAL RHINORRHEA. WESSLEY, Ztschr. f. Hals-, Nasen- u. Ohrenh. **44:** 268, 1938.

The author cites a case of cerebrospinal rhinorrhea which followed a severe sinal infection—post scarlatinal—and lasted six years, finally terminating fatally.

A large defect in the lamina cribrosa on one side, with prolapse of the brain through this defect, was observed post mortem.

He believes that while cerebrospinal rhinorrhea in itself is not acutely dangerous, in that the patient may survive for some time, it always terminates in meningitis. The danger of a fatal termination is always accentuated by the presence of acute infection of the upper part of the respiratory tract.

PERSKY, Philadelphia.

Miscellaneous

LUNG ABSCESS AND ITS RELATION TO SURGERY OF THE UPPER RESPIRATORY TRACT. H. MORRISON, New England J. Med. **218:**669 (April 21) 1938.

The otolaryngologist rarely, if ever, sees pulmonary abscess as a complication of operative conditions. Studies of large series of cases of tonsillectomy show pulmonary abscess occurring on the average once in 2,000 or 3,000 cases.

In 1925 F. T. Lord reported 227 pulmonary abscesses observed at the Massachusetts General Hospital between 1909 and 1924. Of these, 96 (42 per cent) followed operative procedures; 78 (34 per cent) followed operations on the upper part of the respiratory tract, of which 21 (9 per cent) occurred after the extraction of teeth, 49 (22 per cent) after tonsillectomy and the remaining 8 after operations elsewhere. Aspiration of foreign bodies was responsible for 8 abscesses. In this series 28 (12 per cent) of the abscesses were ascribed to pneumonia. One followed esophagoscopic examination. The cause of the rest was not determined.

From the point of view of the prevention of abscess of the lung, several propositions stand out: Tonsillectomy and other operations on the nose and throat are major surgical procedures. They should be performed in a hospital, and the patients should be carefully followed. Local anesthesia is preferable to general, but more important than the type of anesthesia is the qualification of the anesthetist. It is well established that the danger of pulmonary abscess after tonsillectomy is much greater in adults than it is in children.

Extractions of teeth should be done in several sessions, obviating general anesthesia and too large a wound and minimizing the danger of aspiration of a foreign body.

GENGENBACK, Denver. [AM. J. DIS. CHILD.]

ANATOMIC INTRACRANIAL LESIONS IN RETROBULBAR NEURITIS. G. SOURDILLE, Arch. d'opht. **1:**3 (Jan.) 1937.

After reporting 25 cases of retrobulbar neuritis in which intranasal operation was performed, the author discusses in some detail the anatomic relation of the optic nerves to the sinuses and the meninges. He feels that this relation is important in the causation of retrobulbar neuritis in some cases and suggests that surgical treatment is imperative (1) in all cases of optic neuritis, even when recent important malformations of the nose are present; (2) in cases in which there is

no apparent nasal lesion but the symptoms of the neuritis show characteristics which can be interpreted as due to arachnoiditis, and (3) in cases in which improvement does not occur in spite of medical treatment. The author emphasizes the nonspecific character of this surgical procedure. In his opinion a definite etiologic factor, such as multiple sclerosis or syphilis, is not a contraindication to operation if the medical treatment seems to be without effect.

S. B. MARLOW. [ARCH. OPHTH.]

NEUROTROPHIC VIRUS INFECTIONS AND THEIR OTORHINOLARYNGOLOGIC SYMPTOMS. J. DESPONS, Rev. de laryng. **59**:397 (April) 1938.

Since the eighth nerve is covered by a meningeal sheath as far as the internal auditory meatus, meningitis readily involves the labyrinth. Secondary syphilis is particularly prone to affect it. Electrical stimulation permits the differentiation of labyrinthine from neural involvement. In lesions of the nerve trunk studies of chronaxia show an elevation of the threshold. In general peripheral lesions of the vestibular apparatus involve the cochlea also. With central lesions, the two are frequently not associated. Romberg's sign is present with peripheral lesions and absent with central ones. The position of the head influences falling in the presence of peripheral lesions only. The author tabulates the vestibular findings useful in locating the level of the central lesion. Since Bell's palsy may be due to an infection instead of cold, vestibular and cochlear examinations should be made. A complete neurologic survey includes a study of the motor activities of the larynx and pharynx, as well as the plotting of areas of sensation in the mucous membranes of these regions. Such complete studies will aid in a concise diagnosis and establish the essential infectious character of many conditions.

BATSON, Philadelphia.

ORBITAL INFLAMMATION. F. CARAMAZZA, Riv. oto-neuro-oftal. **15**:1 (Jan.-Feb.) 1938.

Caramazza describes 12 cases of orbital lesions, in 9 of which the condition was inflammatory.

Two types of inflammatory lesion can be differentiated: a circumscribed type and a diffuse type, the former gives rise to a suppurating cavity and has a much less grave prognosis than the latter, which produces rapidly invasive necrosis of the tissues.

On the first day of the diffuse inflammatory lesion the local and general clinical signs are marked. The general condition is serious, as the disease is septicemic, with an elevated temperature; locally there is rapidly increasing edema. Usually on the second day the edema is not limited to the lids but extends to all the orbital tissues. The ocular bulb becomes compressed, and a disturbance of nutrition takes place; the cornea becomes so edematous that it is impossible to see the iris, and the conjunctiva is chemotic and becomes lardaceous. The general and local symptoms rapidly become more marked; the tissues of the lids, the conjunctiva and the orbital contents become necrotic, and death usually follows, either by pyemia, septicemia or intracranial extension.

Circumscribed inflammation gives rise to the rapid formation of an abscess, and although one cannot exclude the possibility of a fatal outcome, generally a more favorable prognosis can be given. Often one may succeed in saving the globe and occasionally visual function.

In both types osteomyelitic lesions may result.

In all cases of inflammation of sinal origin Caramazza observed infection of a maxillary sinus, either alone or in conjunction with infection of other sinuses. Also, the most serious orbital infections were always accompanied with maxillary sinusitis.

Therapeutically, the author feels that early cleansing of the orbit and the surrounding infected sinuses should be done.

In 1 case of severe diffuse inflammation with gas gangrene Caramazza obtained immediate cessation of the symptoms, both local and general, on exenteration of the orbit and treatment of maxillary sinusitis of dental origin. The result was unusual, as doubtlessly the outcome has always been fatal. Caramazza feels that in all cases of severe involvement systematic surgical cleansing of the orbit and sinuses should be done. This is true, of course, only of such cases, but the cleansing should be done early enough to avoid all intracranial extension.

Twenty-seven photographs and diagrams accompany the article.

F. P. GUIDA. [ARCH. OPHTH.]

NASAL SYNDROME WITH TRIGEMINAL NEURALGIA FOLLOWING A TRAUMATIC LESION OF THE CORNEA. F. AGNELLO, Riv. oto-neuro-oftal. **15**:79 (Jan.-Feb.) 1938.

Agnello describes 2 cases of a nasal syndrome with neuralgia of the trigeminal nerve following trauma to the cornea by a finger nail. Symptoms were primarily ocular pain and profuse rhinorrhea. The condition was resistant to local therapy and local anesthesia. Therapy to improve the patient's constitution brought about a rapid disappearance of the neuralgia. F. P. GUIDA. [ARCH. OPHTH.]

THE ORIGIN AND TREATMENT OF SPASTIC DYSPHONIA. BERENDES, Ztschr. f. Hals-, Nasen- u. Ohrenh. **44**:78, 1938.

The author classes spastic dysphonia as a symptom complex belonging to a group of psychically related functional disturbances in speech. Locally, there is a disturbance in the motion of the vocal cords, which results in a splitting of the sound into two syllables. This may lead to definite impairment of speech or even aphonia. The disturbance involves not only the larynx but the accessory apparatus of phonation and even the breathing apparatus.

The treatment depends on the psychopathic state of the patient and the environmental conditions and their influence. Psychotherapy must be instituted, and the patient must be trained so that not only does a desire to speak develop but a definite conviction that he will be able to speak properly.

In all such cases the prognosis is good, provided the patient is handled properly. While the otorhinolaryngologist can readily diagnose this condition, the author believes that the treatment really lies in the realm of the psychiatrist.

PERSKY, Philadelphia.

THE STATUS AND DANGERS OF CISTERNAL BLOCK AND ITS AVOIDANCE. ZANGE, Ztschr. f. Hals-, Nasen- u. Ohrenh. **44**:101, 1938.

The author states that, of the three types of subarachnoid block—that is, the cerebral, obstructing the ventricular openings; the cisternal, obstructing the cisterna magna occipitalis, and the spinal—the cisternal is the most important and most serious. It produces a constriction of a part of the brain substance, usually the cerebellar tonsil, with paralysis of respiration. It may occur as an increase in volume of the contents of the brain, an increase in the contents of a ventricle or a swelling of the brain (due to edema, growth, encephalitis or internal hydrocephalus, hemocephalus or pyocephalus). In meningitis, while block is uncommon, it might occur with cerebral edema. In a series of 70 patients with meningitis, 11 had cisternal block. In 4 of these, the condition had the appearance of a plastic exudative cyst, while in 6 it showed evidence of edema and swelling of the brain and was associated with internal hydrocephalus.

The diagnosis of cisternal block is often difficult for the following reasons: 1. Respiratory paralysis does not present its symptoms until late. The early

symptoms may be obscured by the picture of cerebral or meningeal disease. 2. The block does not occur immediately after the spinal tap. 3. The diagnosis of cisternal compression cannot be made with the aid of lumbar puncture alone, since disturbances of breathing may occur as a result of the underlying disease. If disturbances of breathing occur, then the presence of a block may be surmised. A cisternal block, in either of its two forms—that is, the harmless plastic or the dangerous compressive form—can be diagnosed by combined cisternal and lumbar puncture.

The block can be prevented by increasing the pressure of the spinal fluid or by ventricular puncture. When the block is incomplete, it might be possible to force the brain substance back into the cranial cavity. In addition, one should use a ventricular puncture to reduce the increased pressure. The author stresses the necessity of care in doing a spinal tap, so that a block is not produced or an existing block overlooked, and especially in the presence of a cerebral tumor. The spinal tap is of questionable value in the diagnosis of hydrocephalus internus, and differential diagnosis is possible only through ventricular puncture, which also has a therapeutic effect.

In conclusion, while he outlines the value of both lumbar and cisternal lumbar puncture from the diagnostic and therapeutic standpoint, he also warns against the dangers of cisternal block.

PERSKY, Philadelphia.

THE TREATMENT OF CONGENITAL FISTULA OF THE NECK BY ELECTROCOAGULATION. GUSTAV HOFER, Ztschr. f. Hals-, Nasen- u. Ohrenh. **44**:279, 1938.

The author reports a series of 8 cases in which cervical fistula (congenital) was treated by electrocoagulation, with complete cure.

PERSKY, Philadelphia.

News and Comment

CASSELBERRY FUND AWARD

A sufficient sum having accrued from the Casselberry fund for encouraging advancement in the art and science of laryngology and rhinology is now available, in part or as a whole, for a prize award or decoration or to defray the expense of original investigation or research in the domains mentioned.

Theses or reports of work must be in the hands of the secretary of the American Laryngological Association, Dr. Charles J. Imperatori, 108 East Thirty-Eighth Street, New York, before Feb. 1, 1940.

Society Transactions

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY

HAROLD I. LILLIE, M.D., *President*

Forty-Fifth Annual Meeting, Chicago, May 9, 10 and 11, 1939

E. W. HAGENS, M.D., *Editor of Abstracts*

SYMPOSIUM ON THE CARE OF THE PATIENT AFTER OPERATIONS FOR SEPSIS OF OTITIC ORIGIN

This symposium will be published in full, with discussion, in a later issue of the ARCHIVES.

CARE OF MASTOIDECTOMY WOUNDS

COMPLETE MASTOIDECTOMY OPERATION FOR SINUS THROMBOSIS OR OPERATION ON THE PETROUS PYRAMID. DR. MARVIN F. JONES, New York.

The postoperative period may well overshadow the operation; painless dressings, good cosmetic result and a short period of disability are essentials at this time. The suture, drains and dressings vary with operators; my methods are a result of fifteen years' experience. In cases of petrositis the small pathway usually present must be kept open. Removal of granulations is frequently necessary; secondary plastic operation is carried out later. When the approach is via the gasserian ganglion oil silk drains are used, being fixed by large safety pins to prevent change or loss. Wounds should be left alone as much as possible and not overtreated.

RADICAL MASTOIDECTOMY OF THE MODIFIED OR STANDARD TYPE. DR. J. MORRISSET SMITH, New York.

The wound following radical mastoidectomy is often overtreated because of failure to prepare the cavity properly. After making the cavity I line the bony walls with rubber tissue (or gauze treated with liquid petrolatum). If possible the dressing is left out after the second or third change, especially if the cavity is free of blood. When necessary a ring curet is used to remove granulations. In the cavity following the modified radical operation the rubber tissue is placed not in the region of the ossicles but posteriorly. I use a flap operation for closure in such cases.

OPERATION FOR ABSCESS OF THE BRAIN. DR. HAROLD G. TOBEY, Boston.

The time of drainage of an abscess of the brain is usually four to five weeks. The site of drainage presupposes thorough mastoidectomy. Operation through a clean wound is carried out according to the case. Direct extension from the mastoid to the abscess of the brain is found with subacute and chronic aural conditions but rarely with acute ones. Various methods of drainage may be discussed, such as simple evacuation and removal of a cone-shaped section of overlying brain tissue by diathermy. Rubber tubing (noncollapsible) or the Mosher wire basket is used in drainage. Irrigations are not carried out. Dressings should be done daily. Iodized poppyseed oil has not proved successful in outlining extensions of

the abscess. To reduce pressure and to aid in diagnosis I recommend careful lumbar puncture. With cerebellar abscess lumbar puncture may produce serious results.

DISCUSSION

Dr. Westley M. Hunt, New York: I have not had the experience nor the good fortunte with modified radical mastoidectomy that Dr. Smith has had. It has always seemed to me that the success of the care of the cavity after radical mastoidectomy depends on a few simple points. The first is complete drainage so that after one finishes the operation one can take a probe and discover no cesspool. That necessitates the taking down, often, of the facial ridge to a considerable degree.

The second is closure of the eustachian tube. I have as yet found no satisfactory method of being sure of this.

The third is the taking down of the hypotympanic area. Fourth is an adequate external meatus. That is important in the dressing and in proper aeration of the cavity. I am not so enthusiastic about the skin graft as I used to be. I was taught to place a skin graft over any exposed sinus or dura. I do not do that any more because I have seen accidents which I attributed to that procedure.

Dr. Arthur C. Jones, Boise, Idaho: A trick I have picked up in the last few months is the use of the sticker tape which is used in dry goods stores for closing packages. I have been using that as sterilized tape for postmastoidectomy dressing when I can take off the bandage. It does not irritate the neck; it does not pull the hair, and no secretion forms underneath it.

Dr. J. Marion Sutherland, Detroit: A balloon is presented, which is inflated after being introduced into the cavity left by radical mastoidectomy through the external auditory canal. It keeps the granulations under the same pressure and dilates the external auditory canal.

Dr. J. Morrisset Smith, New York: My present impression about the endaural approach for radical mastoidectomy is that, though I have seen Dr. Lempert do the operation very well, it is more difficult for the average surgeon. I think he will do a better operation, and probably get along better, with the postauricular incision and the external ear laid out of the way, with free access to the cavity.

SYMPOSIUM ON FINAL RESULTS OF OPERATIONS FOR CHRONIC SUPPURATIVE PARANASAL SINUSITIS

This symposium will be published in full, with discussion, in a later issue of the Archives.

Cuts and Captions: Five Editorial Years in Retrospect. Dr. Lyman G. Richards, Boston.

(The editor of the Transactions presented a discussion of the growth and changes in the character and number of papers presented before the society during the year. Difficulties arising in publication of the Transactions were mentioned.)

SYMPOSIUM ON VOCAL DEFECTS

This symposium will be published in full, with discussion, in a later issue of the Archives.

Directory of Otolaryngologic Societies *

FOREIGN

Collegium Oto-Rhino-Laryngologicum Amicitiæ Sacrum

President: Dr. Louis Ledoux, Brussels, Belgium.
Secretary: Prof. Dr. C. E. Benjamins, Verlengde Heereweg 143, Groningen, Netherlands.

Hungarian Otolaryngological Society

President: Dr. V. Zimányi, Zárda-u. 48, Budapest II.
Secretary: Dr. G. Kelemen, Reáltanoda-u. Budapest IV.

Sociedad Rioplatense de Oto-Rhino-Laringología (Argentine Section)

President: Dr. Raul Becco, B. Mitre 1690, Buenos Aires.
Secretary: Dr. Juan Manuel Tato, Santa Fé 1171, Buenos Aires.

Société Française d'Oto-Rhino-Laryngologie

Secretary: Dr. Henri Flurin, 19 Avenue Mac-Mahon, Paris, 17e.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. A. W. Proetz, 3720 Washington Blvd., St. Louis.
Secretary: Dr. Leroy A. Schall, 270 Commonwealth Ave., Boston.
Place: New York. Time: June 10-14, 1940.

American Academy of Ophthalmology and Otolaryngology

President: Dr. George M. Coates, 1721 Pine St., Philadelphia.
Executive Secretary: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: Chicago. Time: Oct. 8-13, 1939.

American Bronchoscopic Society

President: Dr. Lyman Richards, 319 Longwood Ave., Boston.
Secretary: Dr. Paul H. Holinger, 1150 N. State St., Chicago.

American Laryngological Association

President: Dr. James A. Babbitt, 1912 Spruce St., Philadelphia.
Secretary: Dr. Charles J. Imperatori, 108 E. 38th St., New York.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President: Dr. Lee M. Hurd, 39 E. 50th St., New York.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester, N. Y.
Place: New York. Time: June 1940.

SECTIONS:

Eastern.—Chairman: Dr. John R. Simpson, Medical Arts Bldg., Pittsburgh.
Place: Pittsburgh. Time: January 1940.
Southern.—Chairman: Dr. Walter J. Bristow, Doctors Bldg., Columbia, S. C.
Place: Columbia, S. C.: Time: January 1940.
Middle.—Chairman: Dr. Sam E. Roberts, Professional Bldg., Kansas City, Mo.
Place: Kansas City, Mo. Time: January 1940.
Western.—Chairman: Dr. Pierre Viole, 1930 Wilshire Blvd., Los Angeles.
Place: Los Angeles. Time: January 1940.

AMERICAN OTOLOGICAL SOCIETY

President: Dr. Horace Newhart, 527 Medical Arts Bldg., Minneapolis.
Secretary: Dr. Thomas J. Harris, 104 E. 40th St., New York.